Guide to Community Energy Profiling

Ontario

Ministry of Energy

Honourable Robert Welch,Q.C. Minister

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GUIDE TO COMMUNITY ENERGY PROFILING

DRAFT

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Introduction

This guide is intended to assist municipal officials preparing community energy profiles. Energy profiling is seen as one element of a community energy management process aimed at reducing dependence on oil, increasing the efficiency of all energy uses, and enhancing the contribution of indigenous and renewable resources.

Section 1 overviews the provincial energy problem and policy context. It briefly describes Ontario's current energy situation, including supply and consumption, and presents projections for the future. Ontario's energy policies and targets are summarized and the municipal role in meeting these objectives is outlined.

Section 2 covers the community energy management context within which community energy profiling occurs. It briefly outlines two main components of the planning process that culminates in a community energy management program plan. The first component, including the community energy profile, emphasizes information; the second, policy/program options, stresses evaluation. Profiling follows an iterative approach that begins with a rough approximation (Round 1 profile) and eventually, after several rounds, may result in a comprehensive data base for community energy

management.

Section 3 sets out a five-step process for conducting a Round 1 community energy profile. Each step is explained in detail.

The Appendix provides information on common energy units and conversion factors. References on profiling, examples of community energy profiles and a review of the profiling experience to date are presented in the accompanying volume, *The Community Energy Profile: Concepts, Methods, Applications*.

This guide is presented in draft form to enable its methods to be tested and refined. Suggestions for changes that may improve the profiling approach or specific techniques are welcomed. Contact:

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Section 1
The Provincial Energy Problem/Policy Context

Section 1 is provided here in abbreviated form. See Ministry of Energy, *Ontario Energy Review*, March 1981, or subsequent edition, for details.

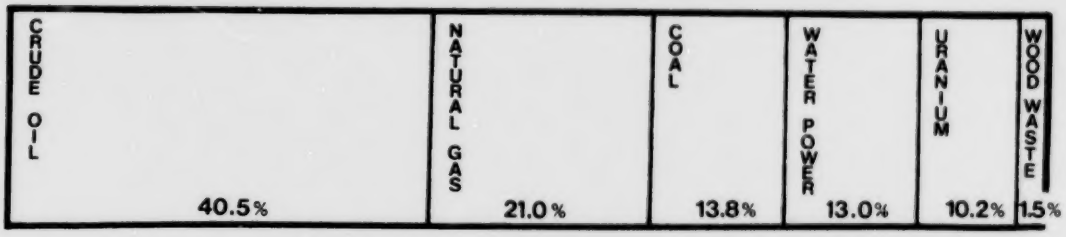
Ontario's Energy Problem

- Vulnerability to changes, in energy supplies and prices, occurring outside the borders of the province.

Supply

- Two main supply risks: international crude oil supply disruption by major producing countries; and a failure to proceed with developments of oil resources in Canada.
- Ontario produces only about a quarter of the energy it consumes. Most of that production is electricity.

Ontario Primary Energy Sources 1979



Source: Ontario Energy Review, March 1981

- Focus of Ontario energy supply problem is oil, which meets 41% of Ontario's primary energy needs. Natural gas supplies in Canada exceed demand and will continue to do so for the foreseeable future. Ontario has a surplus of electricity, supplied mainly from water power and uranium. Most of the coal used in the province is imported but coal is not of major significance. Renewable and recoverable energy sources account for about 14% of Ontario's energy supply.
- Forecasts indicate that, despite the current glut of oil on world markets, there may not be enough crude oil to meet world requirements as early as 1985. As oil supplies tighten, prices will become even more unpredictable.
- Canada now imports nearly a fifth of its oil requirements to meet the gap between demand and

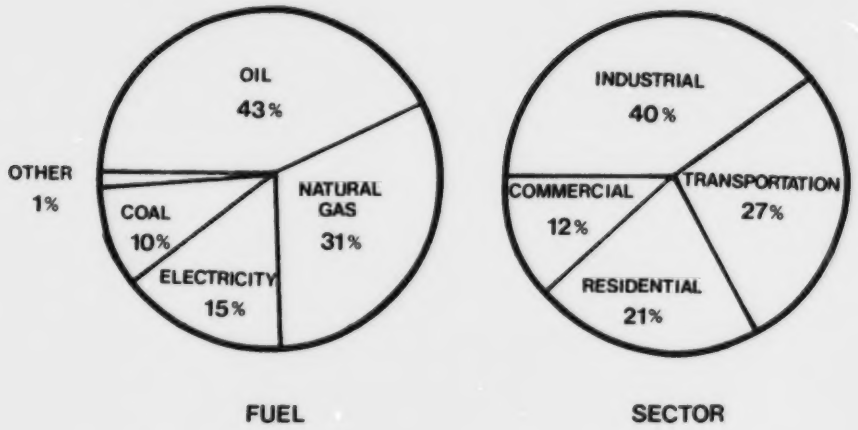
domestic supplies. Longer-term national self-sufficiency in oil is possible but depends on large investments being made (almost $440 billion by the year 2000) and on reducing domestic demand for oil.

- About 91% of Ontario's crude oil supply comes from Western Canada. In the event of a world oil supply crisis, however, available Canadian supplies would have to be shared among the provinces and possibly with other nations.

Consumption

- Canadians consume more primary energy per capita than any other large industrial country. Factors such as climate and geography only partly explain tnis high rate of consumption.
- Total oil consumption in Ontario fell off briefly in 1975 but has since maintained a steady increase. Half of Ontario's oil consumption occurs in transportation. Residential household uses consume another 13%.

Ontario Energy Consumption 1980



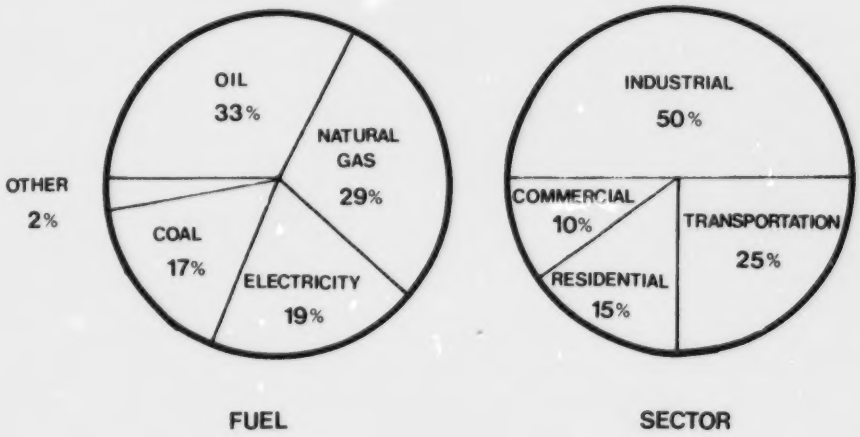
Source: Ontario Energy Review, March 1981

- Natural gas consumption grew rapidly to the mid-1970s, then increased slowly, and since then has experienced an upsurge as a result of home heating conversions. Industries, however, remain the main user (54%).
- Consumption of electricity historically has grown at about 7% annually. Since 1974 this rate has been only 3.9% and it continues to decline.
- Prices of home heating oil and natural gas have increased faster than incomes only since 1973. An escalation of this trend is now occurring as a result of the 1981 Canada-Alberta energy agreement.

Projections

- Ontario's total primary energy requirements are projected to grow 2.1% in the decade 1980-90 and 1.5% from 1990 to 2000; the average rate is 1.8% over the 20-year period.
- The future growth rate of secondary energy consumption by the year 2000 is expected to be lower than in the past – an average of 1.5% annually for 1980-2000.

Ontario Energy Consumption 2000



Source: Ontario Energy Review, March 1981

- Shares of fuels and sectors are expected to change somewhat during the next 20 years. Oil will have a declining role in meeting Ontario's total energy requirements although in the short run, imports of oil may increase. Electricity's share is expected to increase.

Ontario's Energy Policies

- To support national crude oil self-sufficiency by 1990.
- To reduce requirements of oil by substituting other fuels and by practicing conservation.
- To increase energy supply through development of conventional and new sources, produced as far as possible from in-province resources.
- To increase the province's capacity for energy self-sufficiency by 55% by 1995.

Energy Security Targets for Ontario

Sector	Consumption 1980	Conservation Targets	Oil Substitution Targets
Transportation	Total: 625 PJ Auto: 550 PJ	50% improvement in passenger mile per unit fuel consumption and for freight 20% in unit fuel consumption per ton mile by 1995 For Ontario government fleet, 10% improvement in energy efficienty by 1983	Reduce oil share to 90% by 1995 from current share of 99+%
Residential	Total: 471 PJ	30% improvement in average household energy efficiency by 1995 Solar energy to meet 2% of Ontario's energy requirements by 1995 (enough to heat 700,000 homes)	Reduce oil share to 10% by 1990 from current share of 35%
Commercial	Total: 287 PJ	20% improvement in commercial building energy efficiency by 1995 For Ontario government buildings, 26% reduction in energy consumed by 1985 over 1976	Reduce oil share to 10% by 1990 from current share of 17%
Industrial	Total: 654 PJ	25% reduction in energy per unit output by 1985 over 1975	Reduce oil share to 10% by 1990 from current share of 15%

Note: PJ = petajoule = 10^{15} J

Source: Ontario Energy Review, March 1981

The Municipal Role

Municipal governments, directly and by influencing community residents, can make an important contribution to the achievement of province-wide energy targets. At the same time, a municipality is in a position to reduce the vulnerability of the local economy to increasing energy costs and uncertain supplies. Municipal governments can save energy and money in their own operations, make the community development pattern more energy efficient, and facilitate energy-conserving actions in the community at large.

Section 2
The Community Energy Management Context

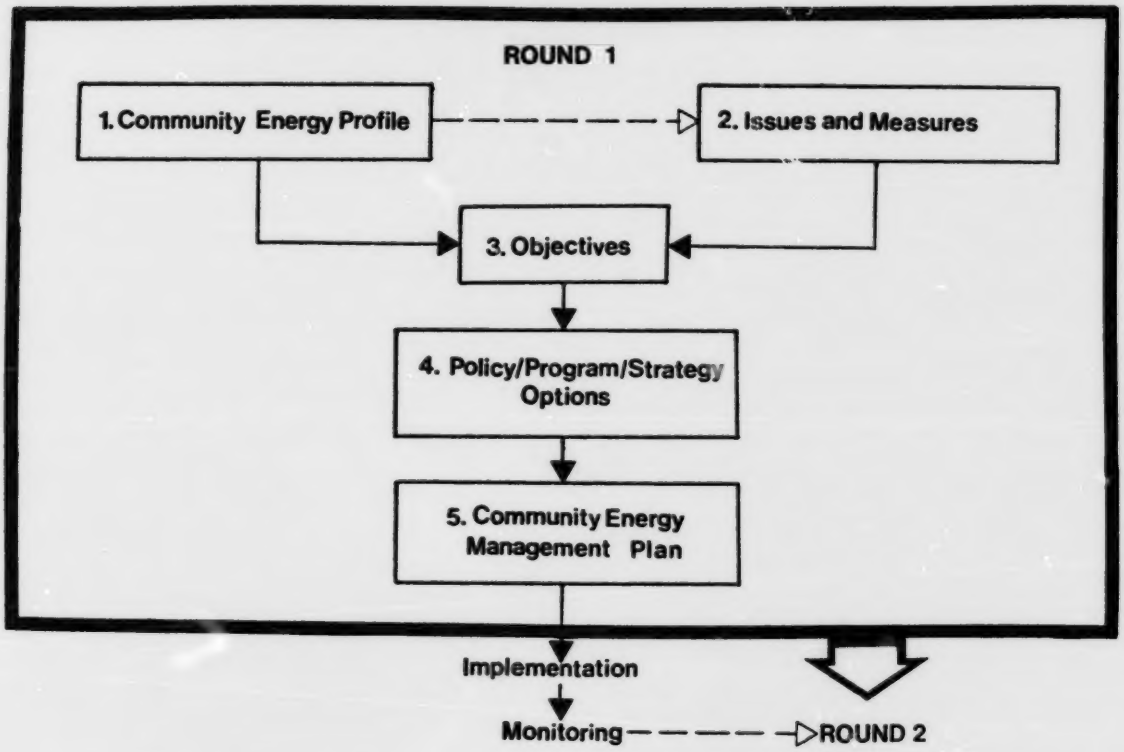
More and more Ontario municipalities are responding to current and anticipated energy problems. They are seeking ways to conserve energy, switch to more dependable energy forms, and develop local energy resources.

Community energy management is a means of making this response through systematic planning and coordinated action. A community energy management program takes an integrated approach to energy measures, in three areas: providing municipal services and facilities; planning and regulating land use and physical development; and facilitating initiatives in the community at large.

Community Energy Management

The planning phase of community energy management has three main components:

1. Assembling an information base;
2. Evaluating policy/program options; and
3. Formulating the community energy management program plan and implementation strategy.



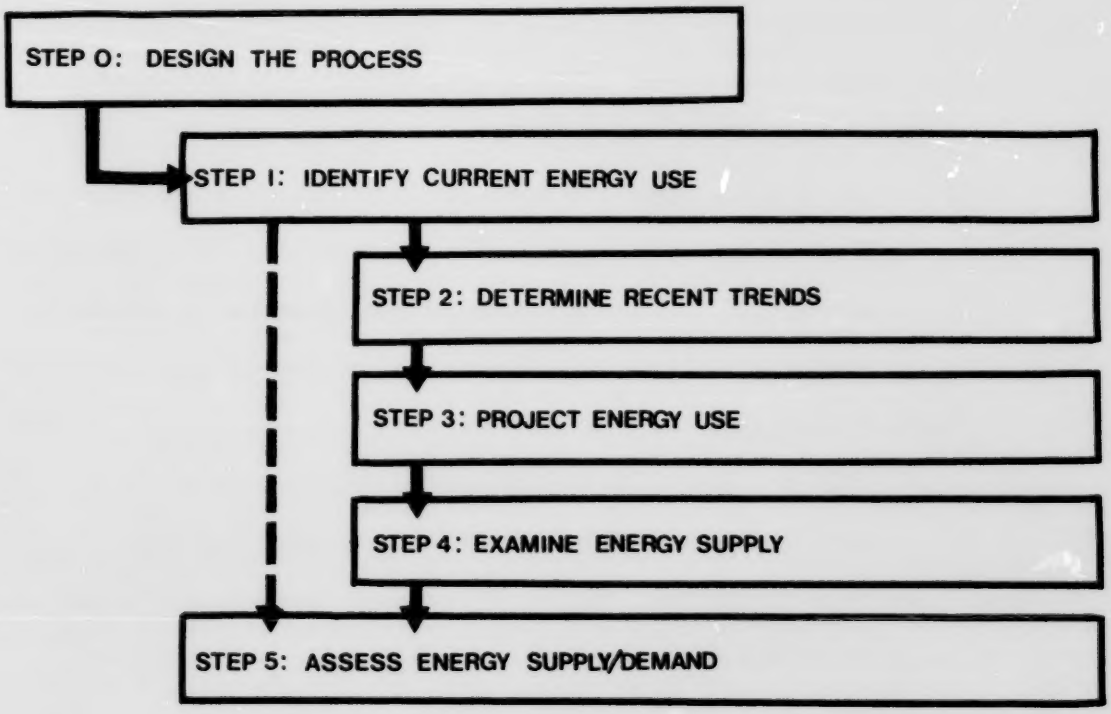
An Iterative Community Energy Planning/Management Process

The energy planning process is not necessarily a simple sequence of 1-2-3. The five steps shown above are likely to be repeated several times. That is because many unknowns exist and there is not much experience in this field; also, the planning and implementation tools, along with public and political support for energy-related actions, are not yet well developed. For these reasons, municipalities are advised to take an iterative approach to energy planning and work gradually toward a comprehensive, integrated energy management program.

Community Energy Profile

The early stages of community energy planning tend to require two kinds of information input. The first, the community energy profile, is discussed at length here; the other is a preliminary examination of measures and other resources that may be available for use in the community. Together, the two kinds of information assist decision-makers to identify the community's energy problems/opportunities and to proceed with next steps in the planning process.

STEPS IN A COMMUNITY ENERGY PROFILE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STEP 5: ASSESS ENERGY SUPPLY/DEMAND

A community energy profile provides a quantified baseline of data that overviews the local energy situation. The conduct of a typical profile (elaborated in Section 3) follows five steps, preceded by a sixth:

0. *Designing the profiling process* with emphasis on scope and specificity, available staff and other resources, the required organizational structure and the overall approach.
1. *Identifying current local energy use* for selected fuels, sectors, subsectors and end uses, including costs.
2. *Determining recent trends in local energy use* with reference to at least two previous years, including changes in the community's economic situation over the same period.
3. *Projecting future local energy use* for the community as a whole and by fuel and sector.
4. *Examining local energy supply* to identify where the community's energy comes from, how it is distributed and what alternative energy resources are available.
5. *Assessing the local energy supply/demand* to clarify the community's energy problems and to give a preliminary indication of the potential for conservation, substitution and local energy resource development.

In the assembly of any data base, a key principle is that information should be collected for clearly defined purposes. A major problem in conducting a community energy profile, therefore, is deciding what its scope and specificity should be. In community energy management processes, the purposes to be served by the data are seldom clear at the outset. This produces a risk that the profile will be too encompassing and overly detailed as profilers attempt to second-guess planners and decision-makers. Experience elsewhere has demonstrated that much time, money, effort and credibility can be lost when massive amounts of data are collected and later turn out not to be needed.* Furthermore, the resulting delay postpones implementation of needed measures, and it may weaken the public and political resolve to take action.

An alternative approach, again drawn from experience, is to conduct a community energy profile in successive rounds beginning with a first-cut rough approximation that can be added to and improved in response to specific questions. A Round 1 profile, the focus of this Guide, is likely to give attention to only a limited part of the local energy picture – and not in detail. Subsequent rounds of

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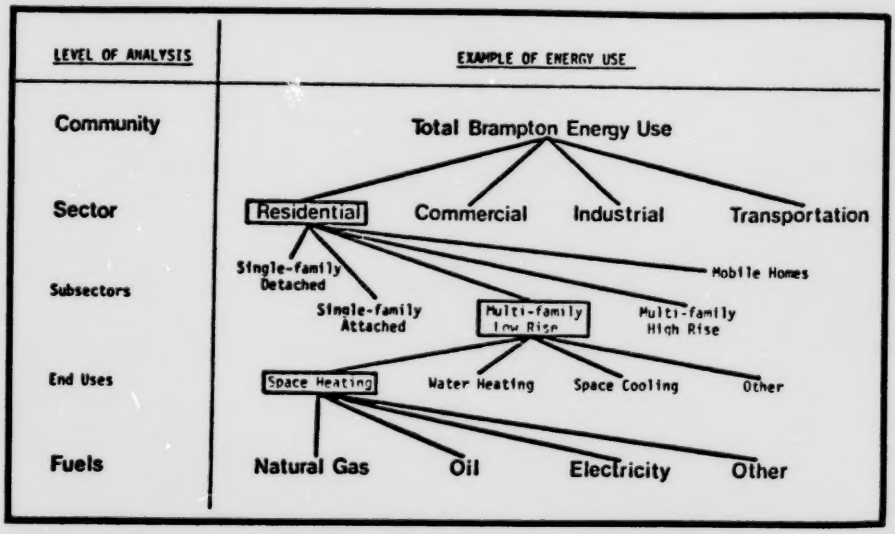
* This experience is described and evaluated in: Reg Lang and Audrey Armour, The Community Energy Profile: Concepts, Methods, Applications (Toronto: Ministry of Energy, March 1982). Available from The Ministry.

profiling can fill in parts of the picture missed in Round 1 while a later stage of the energy planning process, identifying and evaluating policy and program options, can supply the necessary detail. The purpose of a Round 1 profile is to help municipal officials understand energy flows in their community (an example is shown below), set initial energy objectives and focus their examination of possible courses of action.

Energy Flows In Brampton



Source: Local Energy Action Study Team, October 1981

Another risk in energy profiling is the temptation to cram other components of the energy planning process into the community energy profile. If the profile attempts too

much, it will consume a disproportionate share of the available time and budget; more important later steps will be delayed and the entire community energy management process could be seriously set back. Also, a comprehensive package, presented all at once in a new field such as this, is more difficult to "sell" than a staged effort where familiarity and experience can be gained gradually.

A final related risk is in treating energy planning too much as a technical exercise. Public and political support for community energy management tend to result from rather than precede energy planning. For this reason, the planning process needs to be deliberately opened up at key points to inputs from community interests who are part of energy problems and energy solutions. The process should also provide for information-feedback to and from the public at large.

If a Round 1 community energy profile is to be explicitly limited to a rough approximation, it is essential that all involved understand what such a profile does <u>not</u> do:

- While it provides information that enables an initial set of choices to be made, a Round 1 profile does not recommend specific measures to be taken. That comes later in the energy planning process.

- Similarly, while helping to identify policy and program options, a Round 1 profile does not deliver the kind of detailed information needed to evaluate these options.
- A Round 1 profile does not constitute a benchmark of data for monitoring and evaluating energy savings. Normally, such a benchmark would demand a level of accuracy much higher than needed in the first round. After several rounds an energy data base will evolve that may be capable of acting as the required benchmark. Meanwhile, other means (e.g., specific indicators) can be employed for monitoring purposes.

What a Round 1 profile does do is present community decision-makers and others with a broad picture of the community's use of energy, implications of continuing that pattern of use, the main energy problems the community faces, and an initial indication of promising directions to pursue. Such a profile provides a basis for informed discussion and the setting of priorities for the more detailed analysis of policy/program options that follows. The profile can also be a valuable tool for increasing public awareness of the local energy situation and the need for community energy management.

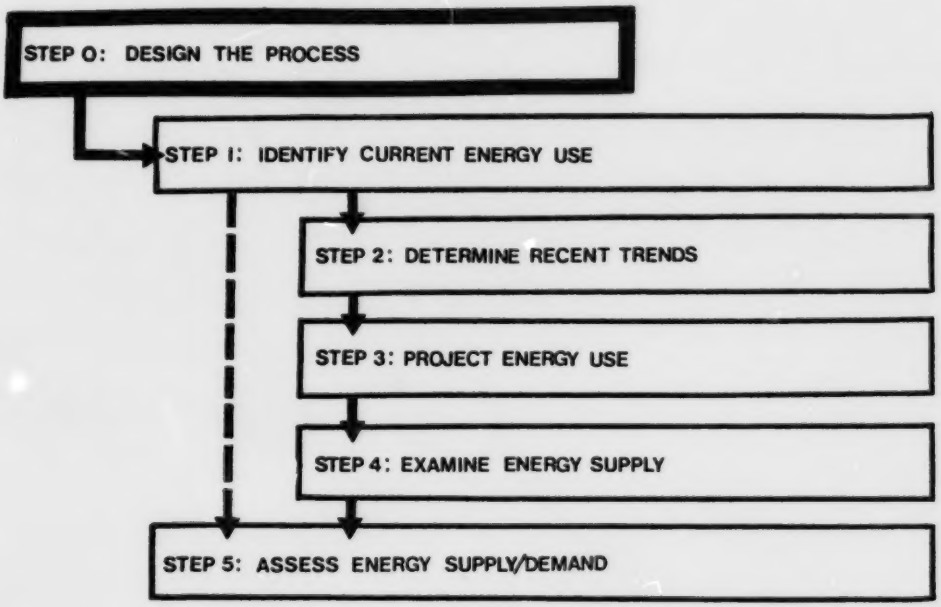
Policy/Program Options

This important, later component of community energy management planning involves, at the outset, deciding which aspects of the local energy situation, presented by the Round 1 profile and the examination of available measures, are most in need of attention. Detailed subsector and user profiles may be required, along with an identification of available measures for conservation, substitution and local energy production. Policy and program options can then be determined and in-depth studies can be made of their payoffs, feasibility and impacts.

Formulating a Community Energy Management Plan

The final component of the community energy management planning process is the formulation of a plan including policies, targets, action programs and implementation strategies. Included as well should be a clarification of the relationship of the community energy management plan to the municipality's official plan and other policies and programs. Provision should also be made for monitoring the results of the energy initiatives taken and the changing energy situation.

Section 3
Conducting A Community Energy Profile
Round One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Step 0: Design the Process

Objective: To set up the process for conducting the Round 1 community energy profile.

Design of the community energy profiling process involves determining what is to be accomplished, by whom, how and over what time period. The following considerations are pertinent:

- Scope and specificity of the Round 1 profile. This determination is central to conduct of the profile. Deciding what the profile is to cover (sectors, fuels, which if any subsectors and end uses), in what detail and to what level of accuracy, however, may be quite difficult at this point. It is recommended that the remaining considerations, below, be explored, and that Steps 1.1 to 1.3 (concerning availability of data) be conducted, before the scope and specificity of the Round 1 profile is finally established. Note that scope also includes deciding whether Round 1 is to encompass all the Steps 1 to 5 or whether a "minimum" profile (omitting trends, projections, costs and the supply side) is sufficient for now.
- Available resources. Besides data, such resources include time, staff, accessibility of outside expertise and funds for these purposes.
- Organizational structure. An early decision required is whether to do the profile in-house, use consultants to assist, or turn the entire project over to consultants. Experience elsewhere emphasizes that consultant work should support

rather than lead the profiling process.* Other questions include: where to locate the project (which department); to whom the project team reports (Department Head, Steering Committee, etc.); who is to manage the project (that person's skills and experience are critical to the profile's success); whether to have an advisory group representing energy-concerned interests in the municipal government and the community at large; and how to maintain liaison with top elected and appointed local government officials.

- Approach. The main question is whether to take a technical approach to the profile and conduct it mainly as an internal exercise, or to use an outreach approach that opens the process to a range of interests and is deliberately educative.

The outcome of Step 0 is a Work Plan for conduct of the community energy profile. This is the first product of the profiling process.

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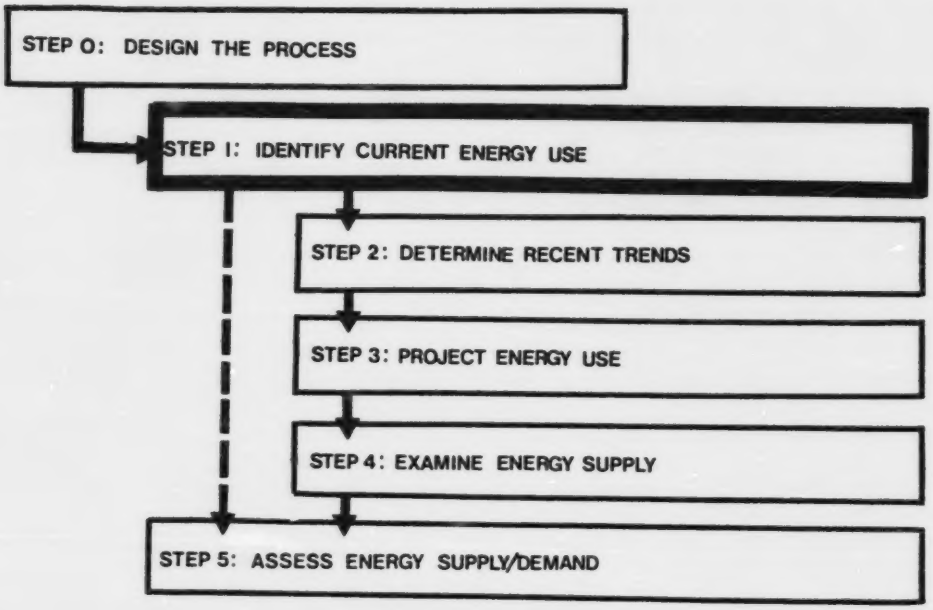
* John L. Moore, et al, The Comprehensive Community Energy Management Program: An Evaluation (Argonne, IL: Argonne National Laboratory, 1981), p. 210. Available from National Technical Information Service (5285 Port Royal Road, Springfield, VA 22161), order no. ANL/CNSV-TM-89, $30.50, or at The Ministry of Energy Library. Organizational issues in energy profiling are discussed more specifically in: Moore et al, Organizing for Comprehensive Community Energy Management Planning: Some Preliminary Observations (A.N.L., Dec. 1979), also available from NTIS, order no. ANL/CNSZ-TM-27, $8.00, or at The Ministry's library.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Step 1: Identify Current Energy Use

Objective: to determine how much and what kinds of energy are used in the community, by whom and for what purposes.

Each community has its own energy identity. This unique pattern of energy use reflects such local characteristics as climate, settlement form and land use, available energy sources, demographic features, industry mix and consumer habits. Describing this pattern, the first step in conducting a community energy profile, involves ten tasks:

1.1 Explore the availability of energy data and its composition.

1.2 Select a base year and common energy unit.

1.3 Decide which fuels, sectors, subsectors and end uses will be covered.

1.4 Determine energy consumption by fuel and sector for the base year.

1.5 Summarize the totals and adjust them, as required, to obtain an overall estimate of total energy consumption for the community in the base year.

1.6 Determine energy consumption for selected subsectors in the base year.

1.7 Determine energy consumption for selected end uses in the base year.

1.8 Determine the cost of energy to the community in the base year.

1.9 Identify any special features of local energy use patterns (e.g., peaking).

1.10 Summarize current local energy use, in both energy units and dollars.

In some circumstances (e.g., where time or data are severly limited) it may be desirable to do a shortened version of the foregoing steps. The above method allows for a "minimum" profile to be conducted. This would omit, in

Round 1, one or more of steps 1.6, 1.7 and 1.8; also it would limit consideration (step 1.3) to main fuels and sectors, omitting subsectors and end uses.

Step 1.1 Explore Availability of Energy Data and Its Composition

Data availability often determines how a community energy profile is conducted – which subsectors and end uses are to analyzed, how much reliance has to be placed on estimating techniques, and whether trends and projections will be included. Generally, the kinds of energy data needed to complete a Round 1 profile, and the data that should be requested from the community's energy suppliers, include:

- Annual sales to residential customers, broken down if required by selected subsectors (such as single-family detached, semi-detached, row and town houses, small apartments, large apartments) and end uses (space heating, water heating, lighting and other).
- Annual sales to commercial customers broken down by selected subsectors (e.g., municipal buildings, municipal services, institutional buildings, retail, offices) and end uses (space heating, space cooling, water heating, lighting and other).

- Annual sales to industrial customers.
- Annual retail gasoline sales.
- Number of customers served by each supplier.

Unfortunately, obtaining this information is seldom a straightforward matter. For example, the needed data are not available from some natural gas suppliers or from most heating oil suppliers. Similarly, retail gasoline sales to the community's residents will not be obtainable. In these cases, the estimating techniques set out in Steps 1.4, 1.6 and 1.7 will have to be used to derive a rough indication of the community's consumption of these fuels.

Further problems encountered with data availability may include:

a. inconsistent categories. "Commercial", for example, typically includes uses (such as institutional and some apartments) not found in this category when applied to land use; also, inclusion of energy users in the commercial category may not be consistent from one energy utility to another, making comparisons invalid.

b. boundary incompatibilities. Energy utilities collect data for their own administrative purposes which may dictate boundaries (e.g., billing areas) that do not correspond to the municipality, to

census tracts or to planning districts.

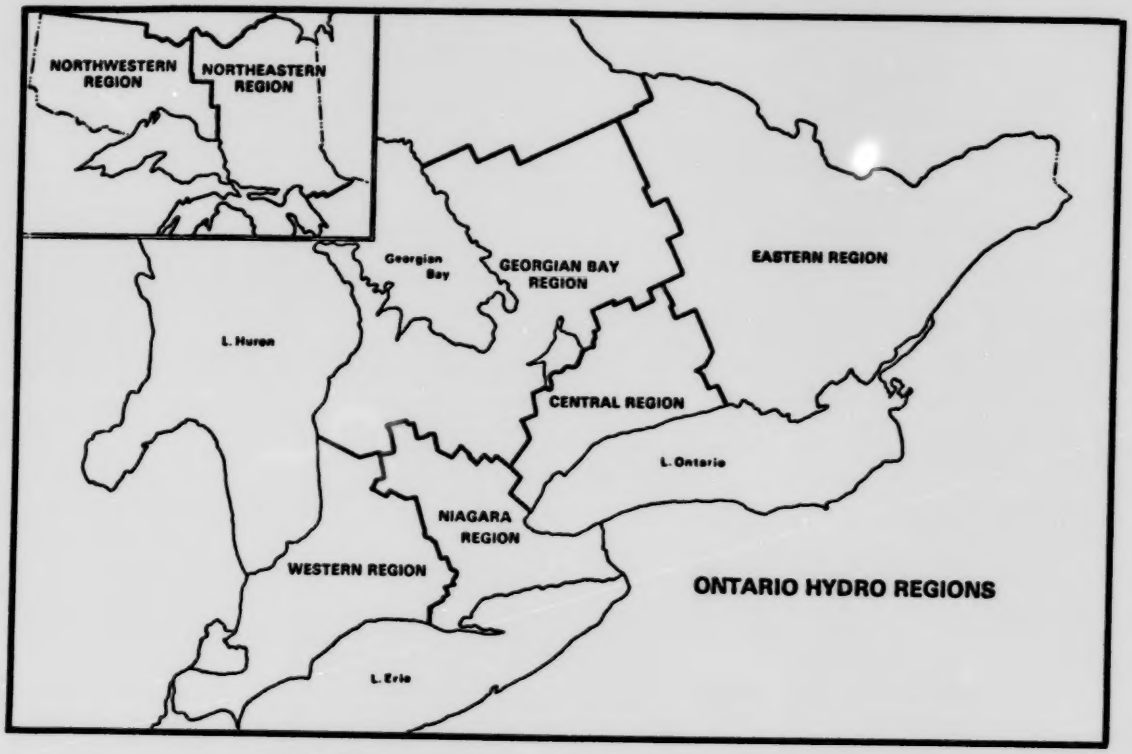
c. different time periods. Energy data may not be readily available for the 12-month period desired for energy planning purposes.

Potential sources of information and some of the specific data-gathering problems that can be expected are described below for each major fuel type.

1.1.1 Electricity

Data on community electrical energy consumption are likely to be easier to obtain than for the other fuels. Most cities and towns in Ontario are served by municipal electric utilities. Much of the information needed to profile the community's electricity consumption can be obtained from them, although the range of available data varies from one utility to the next. Consumption data for customers served directly by Ontario Hydro (includes communities not served by municipal utilities, retail customers in rural areas and certain large industrial users such as pulp and paper companies) can be obtained from the Regional Offices of Ontario Hydro shown on the accompanying map.

More than likely, the municipal utility or Ontario Hydro's Regional Office will be willing to provide the



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requested information; staff time or budget constraints, especially for some of the smaller utilities, may restrict their involvement, however. In any case, a profile of electricity consumption can be prepared using one or more of the following information sources:

Municipal Utility Annual Report which provides information on the number of customers served by sector (residential, commercial and industrial), the amount of electricity consumed by the community as a whole and by each sector, and the cost of that electricity over the year. Note that some electric utilities may group commercial and industrial customers under the single classification "General".

S.I.C. Quarterly Statistics compiled by the municipal utilities and sent to Ontario Hydro's Regional Offices. This reference breaks down the community's customers by Standard Industrial Classification, lists the number of meters in each class (in the residential sector this sometimes corresponds to number of housing units served), and shows average monthly consumption in kilowatt-hours of electricity for each month. To obtain this information contact the local utility or your Ontario Hydro Regional Office (ask for the Supervisor of Municipal Accounts). An excerpt from a computer printout for one Ontario municipality is shown below.

S.I.C. QUARTERLY STATISTICS FOR MUNICIPALITY "X"

S.I.C.	Description	January		February		March		Total	
		kwh	units	kwh	units	kwh	units	kwh	units/mo.
821	Hospitals	571850	3	445625	3	418975	3	1436450	9
822	Health care institutions	50660	3	45400	3	31580	3	127640	9
825	Offices - dentists	61250	7	56	7	47740	7	162746	21

Be sure to check with local utility and Ontario Hydro regional officials regarding possible problems or errors in their S.I.C. statistics (they may know, for example, if some of the data were improperly coded, i.e., assigned to the wrong S.I.C. group when entered in the computer). Knowledge of such errors will make it easier to reconcile totals in the S.I.C. statistics with figures obtained from other sources.

Ontario Hydro Statistical Yearbook. This handy reference provides data on: the total amount of electricity consumed by each municipality in Ontario; the amount consumed by each of four rate classes (Residential; General Service under 5000 kw, which includes all commercial customers,

bulk-metered apartments, small industrial users and government buildings; General Service, over 5000 kw, which includes large industrial users; and Street Lighting); and the dollars spent on electricity, by the community as a whole and by each rate class.

Ontario Hydro Energy Application Survey. Conducted every two years since 1960, this *sample* survey provides data on the percent of residential units that use certain fuels for heating systems (electric, oil natural gas, other), water heaters (electric or gas) and electric appliances. The published survey results are shown for each of Ontario Hydro's regions. Data by municipality are considered confidential by Ontario Hydro but may be obtainable from the municipal utilities that took part in the survey (a list of participating municipalities is shown on the next page). The published survey results are broken down into only a few categories (e.g., single-detached; individually and bulk-metered apartments). For further information and assistance contact: Supervisor, Power Use Statistics, Market Analysis Division, U2A2, Ontario Hydro, 700 University Avenue, Toronto. Phone (416) 592-3688.

ONTARIO HYDRO ENERGY APPLICATION SURVEY 1980:

PARTICIPATING MUNICIPALITIES

Alexandria
Alliston
Almonte
Alvinston
Amherstburg
Arnprior
Atikokan Twp.
Alymer
Barry's Bay
Beeton
Belle River
Belleville
Belmont
Blandford-Blenhein
Blenheim
Blyth
Bothwell
Braeside
Bradford
Brantford Twp.
Brockville
Burford
Caledon
Caledonia
Cambridge-N. Dumphries
Campellford
Capreol
Casselman
Cayuga
Chapleau Twp.
Chatham
Clifford
Clinton
Cobden
Cobourg
Cochrane
Collingwood
Cornwall
Cottam
Deep River
Delaware
Dorchester
Dundas
Dunnville
Durham
Dutton
Eganville
Elora
Erieau
Espanola
Essex
Exeter
Fergus
Forest
Fort Frances
Glencoe
Gloucester Twp.
Goderich
Grand Bend
Grimsby
Hagersville
Harrow
Huntsville
Ingersoll
Kemptville
Killaloe Station
Kincardine
Kingsville
Lancaster
Lambeth
Lincoln
Lindsay
London
L'original
Lucknow
Lynden
Markham
Meaford
Midland
Millbrook
Milton
Mississauga
Mitchell
Mount Brydges
Mount Forest
Napanee
Nepean Twp.
Newcastle
Niagara Falls
Niagara-on-the-Lake
Nipigon Twp.
North York
Norwich
Omemee
Orillia
Ottawa
Owen Sound
Palmerston
Parkhill
Pelham
Pembroke
Penetanguishene
Perth
Peterborough
Petrolia
Picton
Port Colborne
Port Elgin
Port McNicoll
Port Rowan
Port Stanley
Prescott
Renfrew
Richmond Hill
Ridgetown
Rockland
Rockwood
Rodney
St. Catharines
St. Clair Beach
St. Mary's
Sandwich West Twp.
Sarnia
Sault Ste. Marie
Scarborough
Scuboy
Schreiber Twp.
Seaforth
Sioux Lookout
Smiths Falls
Southhampton
Stoney Creek
Strathroy
Sudbury
Tecumseh
Terrace Bay
Thornbury
Thorald
Thunder Bay
Tilbury
Tillsonburg
Toronto
Trenton
Vankleek Hill
Victoria Harbour
Walkerton
Wallaceburg
Wasaga Beach
Waterford
Welland
West Lorne
Whitchurch-Stouffville
Windsor
Wingham
Woodstock
York
Zorra

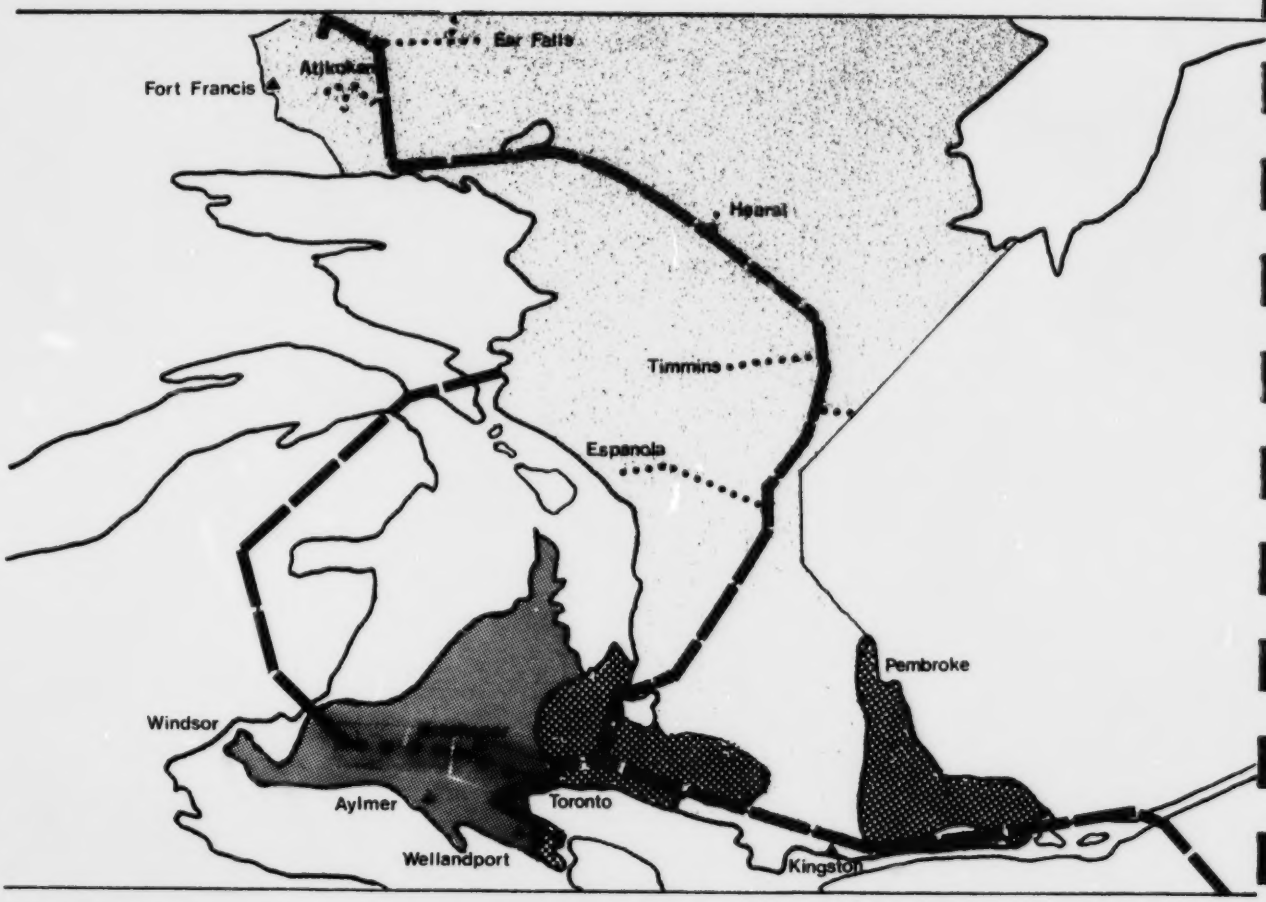
1.1.2 Natural Gas

Distribution of natural gas in Ontario is handled by three large companies and a few smaller utilities. The accompanying map (page 34) shows the service areas of the distributors which include:

- Consumers' Gas Company, covering much of central and eastern Ontario
- Union Gas Limited, covering southwestern Ontario
- Northern and Central Gas Corporation Limited
- Five smaller utilities: Kingston Public Utilities Commission, The City of Kitchener, Natural Resource Gas Limited, Inter-City Gas Corporation, and Wellandport Gas Company.

Each distributor has its own system of data collection. Union Gas is the only large distributor that can provide information (for 1979 onward) on gas consumption by municipality as well as by sector and subsector; the Company has a computerized data system which groups customers according to S.I.C. codes. Consumers' Gas Company gathers its data on a regional basis. The Consumer Gas distribution area is divided into five regions: Metro Toronto, Western, Central, Eastern and Provincial Gas (see map on page 35). Data on gas consumption by sector (residential, commercial,

Natural Gas Supply in Ontario



MAIN DISTRIBUTORS' LINES

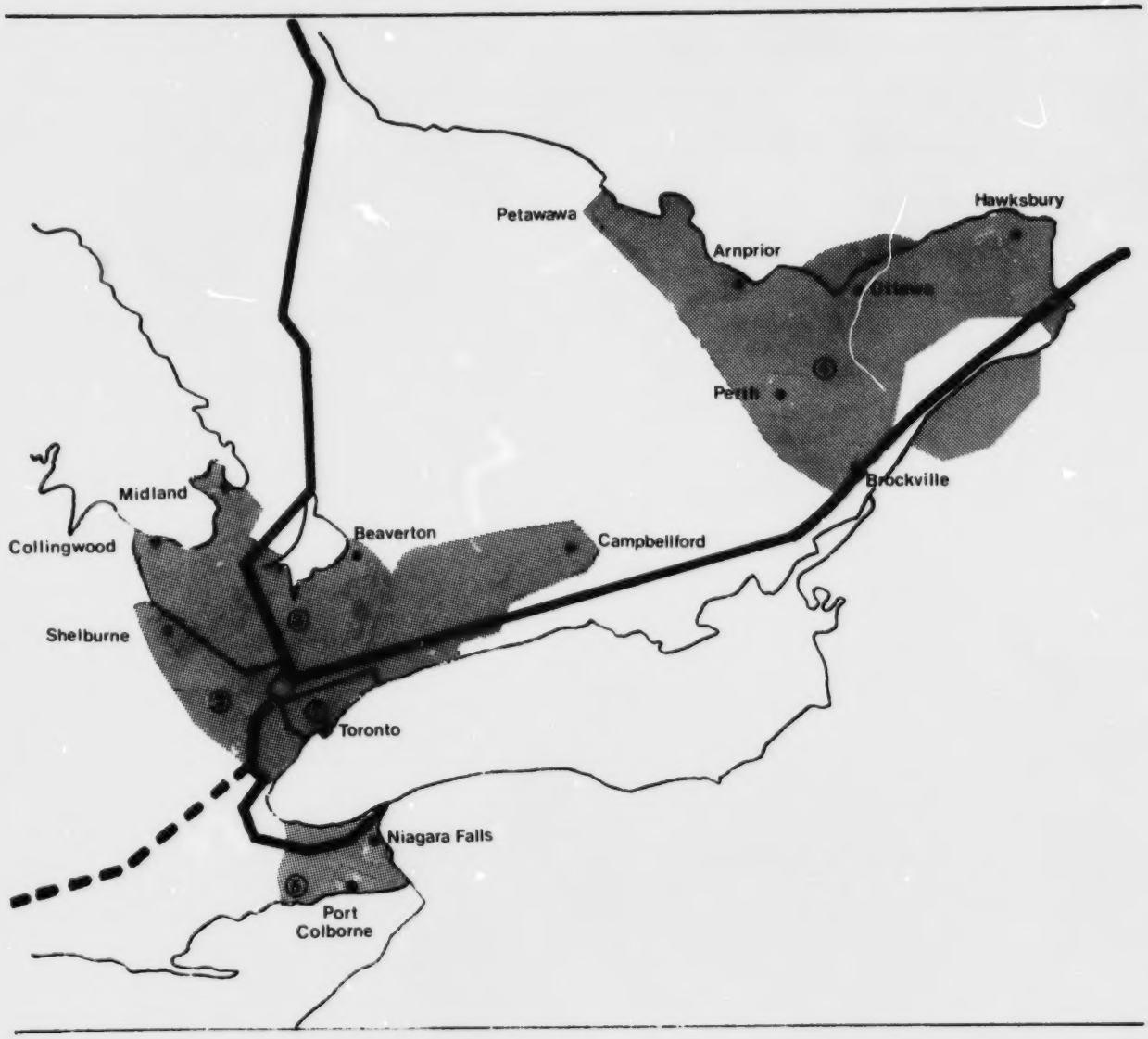
- TransCanada Pipeline System
- Union Gas
- Northern and Central Gas

FRANCHISE AREAS

- Union Gas
- Consumers' Gas
- Northern and Central Gas
- Small Utilities

Source: Ontario Energy Review, March 1981

Consumers' Gas Distribution Regions



① Metro Toronto Region
② Western Region
③ Central Region
④ Eastern Region
⑤ Provincial Gas

TransCanada Pipeline System
Union Gas Pipeline

Source: Consumers' Gas Co. Ltd., Annual Report 1981

industrial) are available for each region; an estimate of gas consumption by municipality will be provided by Consumers' Gas upon written request. Other gas companies should be able to provide similar information, i.e., gas consumption by sector for their region(s) and an estimate of the municipality's proportional share. Requests for such information should be directed to the head office of each distributor:

Consumer's Gas Company
First Canadian Place, Suite 4200
P.O. Box 90
Toronto, Ontario
M5X 1C5
(416) 492-5287

Union Gas Limited
50 Kiel Drive N.
Chatham, Ontario
N7M 5M1
(519) 352-3100

Northern and Central Gas Corporation Limited
245 Yorkland Boulevard
Willowdale, Ontario
M2J 1R1
(416) 491-1880

Kingston Public Utilities Commission
Counter Street at Lappans Lane
Box 790
Kingston, Ontario
K7L 4X7
(613) 546-1181

Natural Resource Gas Limited
P.O. Box 3117
Terminal A
London, Ontario
N6A 4J4
(519) 433-6131

Inter-City Gas Corporation
1700 - 444 St. Mary Avenue
Winnipeg, Manitoba
R3C 3T7
(204) 477-5190

Wellandport Gas Company
211 George Street
Dunnville, Ontario
N1A 2T5
(416) 774-7654

Data on gas consumption by subsector, however, are not generally available and will have to be estimated using other information sources such as:

Ministry of Treasury and Economics, Consumption of Fuel and Electricity by Ontario Manufacturing Industries, Nov. 1981, for data on the quantity of natural gas used in 1979 by each two- and three-digit S.I.C. Industrial Group (total quantity, cost, consumption per employee and per $1,000 of value added). These data are updated each year.

Ontario Hydro, Energy Application Survey (described above under 1.1.1 Electricity), for estimates of the proportion of homes using natural gas for space and water heating.

Statistics Canada, Census Data, which will provide information, by municipality on the main type of heating equipment used in households (back-up heating systems were not counted) and the type of fuel used for water heating.

Only 1971 Census data are available at this time. No definite date has been set for the release of this portion of the 1981 Census. For further information contact: Statistics Canada, Toronto Office, 25 St. Clair Avenue, (416) 966-6586; or Ottawa (613) 593-5078 (publications order department) and (613) 995-2411 (1981 Census information office).

1.1.3 Heating Oil

Heating oil consumption data will not be easy, and may be impossible, to obtain. There may be several (sometimes many) oil distributors supplying the community. These are likely to be small companies that may keep minimal or no records. Data aggregated by sector (residential, commercial, industrial) are unlikely to be available. Individual customer sales information, which could be used to obtain an aggregate consumption figure, may be deemed confidential.

As a starting point, local distributors should be contacted and asked to provide, at a minimum, data on the number of customers they serve in each sector and a figure (actual or estimated) for total gallons of oil sold in the community. In addition they should be asked to estimate "average oil consumption" for typical building types in each residential subsector (e.g., single-family detached, small

apartment, large apartment, row housing) and for commercial and industrial customers.

If these data are unavailable or incomplete, the profiling work dealing with heating oil will have to rely on estimating techniques. Sources of information for estimating oil consumption include:

Ontario Hydro, Energy Application Survey (described above under 1.1.1 Electricity), for estimates of the proportion of homes heated by oil.

Ministry of Treasury and Economics, Consumption of Fuel and Electricity by Ontario Manufacturing Industries, Nov. 1981, (described above under 1.1.2 Natural Gas) for data on the amounts of heating oil consumed by Ontario manufacturing industries.

Robert Macdonald, Gene Desfor and Michael Miloff, Patterns and Levels of Commercial and Industrial Energy Consumption: A Case Study of Metropolitan Toronto (Ottawa: Energy, Mines and Resources, 1979) which provides, for the commercial sector, a set of "energy coefficients" – estimates of the kilowatt-hours consumed per square foot per year for nineteen subsectors.

Statistics Canada Census Data, described above under 1.1.2. Natural Gas.

1.1.4 Gasoline

Major oil companies and gasoline retailers are generally unwilling to provide sales data on gallons/litres of gasoline sold. They regard this information as "confidential". Even when such data are available, a major problem remains: separating sales to residents of the community from sales to non-residents.

Energy profiling generally relies on estimating procedures for gasoline consumption. These are set out in Step 1.4. One of the estimating techniques uses Statistics Canada data on passenger car fuel consumption and fuel sales. See:

> Statistics Canada, Passenger Car Fuel Consumption Survey and Information Manual, published quarterly since October 1979 by the Education, Science and Culture Division. This survey provides data, by province, on distance traveled, total amount of fuel consumed, average distance per unit of fuel, and passenger cars in use. The survey reports are available from the Division.
>
> Statistics Canada, Road Motor Vehicles - Fuel Sales, Catalogue No. 43218.

1.1.5 Other Fuels

Generally, other fuels such as wood, diesel or methane gas represent a very small proportion of the total energy consumed in a community. Normally, these need not be covered in a Round 1 profile.

Summary

Summarize data availability using Worksheet 1.

SECTOR	FUEL				
	Electricity	Natural Gas	Heating Oil	Gasoline	Other Data
Residential					
Commercial					
Industrial					
Transportation					

WORKSHEET 1 DATA AVAILABILITY

Step 1.2 Select a Base Year and Common Energy Unit

"Base year" is the most recent year for which a profile of the community's energy use can be developed. Considerations in the selection of the base year include:

a. availability of energy data for a full year; and
b. availability of other key information such as population (total for the municipality, rate of change, population projections), number of housing units by type and age, average income per household and per capita, commercial floor space, employment statistics (number of employees in commercial and industrial sectors), modal split (or travel patterns of labour force), vehicle registration (by type and age) and annual vehicle miles traveled.

Because some energy data are collected only on a regional, county or township basis, the availability of other key information for one or more of these geographic areas (whichever is appropriate) should also be

investigated. Sources of such information, in addition to local government offices, include:

Ministry of Intergovernmental Affairs, Municipal Directory.

Statistics Canada, Census Data.

Ministry of Treasury and Economics, Ontario Statistics.

Ministry of Transportation and Communications, Licensing and Control Branch 1201 Wilson Avenue Downsview, Ontario (416) 248-3416 for vehicle registration data.

Contacts Influential which lists 66,000 businesses in the Metro Toronto area and provides information on number of employees (the directory can be leased at $695 a year; it is updated monthly). Contact: Contacts Influential, 60 Pleasant Blvd., Toronto (416) 968-2467.

Routing Services publishes four industrial directories and one professional/service directory. These include: 1. Metro Toronto Trade Index (12-month lease $95.00, updated regularly); 2. Greater Toronto Area Directory which covers Oakville, Mississauga, Brampton, Vaughan Township, Thornhill, Richmond Hill, Markham, Pickering, Ajax, Whitby, Oshawa, and Bowmanville (12-month lease $55.00, updated regularly); 3. Hamilton and Niagara Peninsula Directory (can be purchased for $55.00); and 5. Metro Toronto Professional and Service Directory (can be purchased for $120.00). Each directory provides information on number of employees. Routing Services will also prepare a computer printout of industries and businesses by S.I.C. Codes (there is a charge for this service). Contact: Routing Services, 185 Gibson Drive, Markham (416) 475-7171.

Scott's Industrial Directories, Ontario Manufacturers, which provides information on industries and number of employees by municipality (purchase price: $115.00 plus tax and shipping). Contact: Scott's Industrial Directories, 75 Thomas St., Oakville (416) 845-8881.

Special studies, undertaken for other purposes by the municipality, the provincial government, universities, community groups and others.

All energy data will have to be converted to a common unit so that comparisons among fuels and sectors can be made. British Thermal Unit (BTU) is a unit of measure familiar to most people. The SI equivalent is Joules. See the Appendix for definitions of these terms, the energy equivalents of various fuels, and conversion factors.

Step 1.3 Decide Which Fuels, Sectors, Subsectors and End Uses Will Be Covered

A Round 1 community energy profile deliberately narrows the data search to information that is expected to serve specific planning and decision purposes in the initial cycle of community energy management. Such a profile therefore does not cover the full range of fuels, sectors, subsectors, and end uses. It is selective. In Step 1.3, and in an iteration of Step 0, the scope of the profile is determined.

The following fuels, sectors, subsectors and end uses would be included in a typical Round 1 profile. The list should be modified, if necessary, to accommodate any

specific local concerns, problems or opportunities that have already been identified or are anticipated. Note that community energy profiles focus on secondary energy, ignoring: a. the energy required to produce and distribute energy; and b. embodied energy (see Appendix).

FUELS, SECTORS, SUBSECTORS AND END USES RECOMMENDED FOR ROUND 1 CEP

Fuel	Sector	Sub-sector	End Use
Electricity Natural Gas Heating Oil Gasoline	Residential	Single-Family Detached Small Apartments Large Apartments Town/Row Housing	Space Heating Water Heating Space Cooling Other
	Commercial	Municipal Buildings Municipal Services Institutional Businesses	Space Heating Space Cooling Water Heating Lighting Other
	Industrial		
	Transportation	Municipal Fleet Private Automobile Other	

The foregoing categories can be compared with the next table which indicates a full range of possible fuels, sectors, subsectors and end uses. Coverage excluded in Round 1 can be added in subsequent rounds, as required.

RANGE OF POSSIBLE PROFILE CATEGORIES

Fuels	Sectors	Subsectors	End Uses
Electricity Natural Gas Heating Oil Propane Gasoline Diesel Coal Wood Biomass Methane etc.	Residential	Single-family Detached Single-family Attached Multiple Family Low Rise Multiple Family High Rise Row Housing Mobile Homes etc.	Space Heating/Cooling Lighting Cooking Water Heating Clothes Drying Refrigeration Other Appliance Use etc.
	Commercial	Retail Trades Wholesale Trades Personal Services Financial Sercices Business Offices Accommodation Food Services Religious Establishments etc.	Space Heating Lighting Air Conditioning Water Heating Refrigeration etc.
	Industrial	Iron and Steel Mills Pulp and Paper Mills Industrial Chemicals Petroleum Refineries Rubber Products etc.	Direct Heat Motor Drive Electrolyte Processes Space Heating Air Conditioning etc.
	Transportation	Private Automobile Trucks, Vans Public Transit Boats Snowmobiles etc.	Journey-to-Work Shopping Trips Recreation Trips Other Business etc.

The RESIDENTIAL SECTOR, as defined here, includes all privately and publicly owned dwelling units (with the exception of institutional homes, such as college dormitories, hospital residences and homes for the aged, which are included in the commercial sector). The subsector category, "small apartments", includes apartments of fewer than 5 or 6 units while "large apartments" includes those with more than 5 or 6 units (electric utilities use 5 units as a cut-off point; natural gas utilities use 6). Where the electric or gas utility includes any apartments in its "commercial" sector, they should be moved over to the residential sector.

The COMMERCIAL SECTOR includes all other buildings in the community (with the exception of industrial plants and facilities) together with certain municipal services: street lighting, sewage treatment and disposal, and water supply. Commercial buildings are divided into two groups: public and private. Public buildings correspond to the subsectors "Municipal Buildings" and "Institutional"; the latter refers to non-municipal government buildings, educational facilities, health and welfare facilities, religious establishments and public recreational centres. Private buildings correspond to the subsector "Businesses".

The INDUSTRIAL SECTOR is not subdivided here into subsectors or end uses. Municipalities are quite limited in terms of what they can do to reduce energy consumed in the industrial sector; therefore, an analysis of energy consumed by subsector and end use will be of little use in the development of a community energy management program, at least in its early stages. This sector is included in the Round 1 profile only to enable the community's total energy consumption to be calculated. Involving local industries in the Round 1 profile can have other benefits, however. This sector is a potentially useful source of energy management expertise and it may well offer possible alternative energy resources such as waste heat. Subsequent stages in the development of the community energy management program (i.e., additional Rounds of the profile, measures identification and policy development) should include industrial subsector and end use profiles.

The TRANSPORTATION SECTOR is subdivided into two subsectors: Municipal Fleet (which includes public transit) and Private Vehicles. End use is not specified since it is extremely difficult to obtain data or make estimates of transportation and use on a community basis. In any case, such data are not essential in the early stages of developing a community energy management program.

Step 1.4 Determine Energy Consumption by Fuel and Sector

This Step (and Steps 1.6 and 1.7) describes, for each fuel and sector, various techniques that can be used to estimate energy consumption where accurate data are not available. In each case, it is recommended that more than one technique be used so that a range of estimates is produced from which a "best" or average estimate can be selected.

1.4.1 Electricity

Data on the *total electrical energy consumed* in the community for the base year should be readily available from the local utility, usually in its Annual Reports. Total sales (in kwh and dollars) for each municipality are also listed in the Statistical Yearbook. Note that the two sets of figures may not be the same. Brampton's Hydro-Electric Commission's 1979 Annual Report, for example, indicates that 1,143,690,053 kilowatt-hours of electrical energy were consumed in the city during 1979. Ontario Hydro's

Statistical Yearbook, however, shows a total sales figure of 1,121,055,937 kwh. The difference (22,634,116 kwh) may represent the power used by Brampton Hydro itself (e.g., transmission loss) or a difference in billing periods used to calculate totals. Although it would be safe to rely on the figures in the Statistical Yearbook, such discrepancies should nonetheless be discussed with municipal utility officials; the reasons for the difference should be noted in the community energy profile report.

Electrical energy consumed by sector can be calculated by adding the consumption figures for applicable S.I.C. groups in each sector. For the Residential Sector, for example, this would include:

Code	Class
738	Large Apartments, bulk-metered
739	Large Apartments, individually-metered
740	Small Apartments, bulk-metered
741	Small Apartments, individually-metered
742	Row Houses, bulk-metered
743	Row Houses, individually-metered
873	Single-Family

Local utility officials should be able to provide guidance on identifying the S.I.C. codes for each sector. Note that:

1. The S.I.C. Quarterly Statistics do not include data on energy consumed for street lighting. This

information can be found in the Statistical Yearbook, or it may be available from the municipal department responsible for this service. The appropriate figure should be added to the Commercial Sector consumption figure derived from the S.I.C. Statistics.

2. The S.I.C. Statistics will show electrical energy consumption for a variety of transportation-related classes (e.g., S.I.C. Code 503 railway transportation general, 506, 507, 508, 509, 512, 515 and 517). These classes are to be included in the commercial sector unless the electrical energy consumed was used specifically to power the vehicles involved in which case they should be added to the transportation sector.

1.4.2 Natural Gas

Municipalities within the distribution areas served by Union Gas or a municipally owned gas utility should be able to obtain data on total fuel consumed by the community as a whole and by subsector. Contact the head office of each company.

Municipalities served by other gas companies may have to rely on estimating techniques to obtain a figure for the community's natural gas consumption if this information is

available only at the scale of the gas company's regions (check with the company first). The required calculations are shown below:

First Estimate: Total Community Natural Gas Consumption

$$\text{Sales volume for region in base year} \times \frac{\text{Municipality's population}}{\text{region's population}}$$

= Municipality's Gas Consumption

Note: "Region" in the above formula refers to the gas company's regional district.

"Customer" refers to "any individual using gas through a meter in his name". In some cases, the meter may be a master meter, that is, a bulk meter recording gas consumption for several housing units. This situation should arise relatively infrequently, however; according to gas utility officials the trend over the past few years has been to install individual meters. Bulk-metered housing units are classed by gas utilities as commercial customers. Ask local utility officials to separate these out from other commercial customers.

This technique assumes that the municipality's per capita gas consumption is proportional to the per capita gas consumption in the region. Utility officials should be asked to adjust the estimate to reflect any local circumstances that may have influenced gas consumption in the municipality. If the municipality's characteristics differ considerably from those of the region (e.g., a densely built-up central city in a sprawling urbanized region), this technique will be inappropriate. It is probably also invalid at the neighbourhood scale.

Second Estimate: Gas Consumption by Sector

For the residential sector, the following two-step calculation can be used:

(i) $$\frac{\text{Number of residential customers in region}}{\text{Number of housing units in region}} \times \text{Number of housing units in municipality}$$

= Residential customers served by natural gas in the municipality

Gas utility officials should be asked to adjust the result to reflect the municipality's saturation level (% of houses served by natural gas). The saturation level may differ from the regional average.

Gas utility officials should also be able to provide an estimate of average consumption per customer, based on a regional average. They should be asked to make any adjustment necessary to reflect local conditions affecting consumption.

A cross-check on the above estimate can be made by re-calculating residential sector energy consumption using the energy intensity factors (estimated energy demand per unit) developed by the Brookhaven National Laboratory, shown below:

Energy Intensity Factors For Gas Heated Homes
(million BTU/unit/year)

Single Family Detached	Single Family Attached	Low Rise	High Rise
151	106	92	72

Note:

a. These figures are based on 5500 heating degree days Fahrenheit. To adjust for climatic variations add, for every additional 1000 degree days per year:

14 Million BTU per 1000° days per year for single-family detached
12 Million BTU per 1000° days per year for single-family attached
10 Million BTU per 1000° days per year for low rise
7 Million BTU per 1000° days per year for high rise

Degree-day data for Ontario communities are available from Environment Canada, Atmospheric Environment Service (4905 Dufferin Ave., Downsview, Ontario M3H 5T4).

b. These figures do not take into account gas consumed for uses other than heating. For each housing unit that uses natural gas for cooking and waterheating add 37 MCF. If data on the number of housing units with gas ranges and water heaters are not available, ask gas utility officials to make the necessary adjustments.

Source: T. Owen Carroll et al, Land Use and Energy Utilization. Interim Report (Upton, NY: Brookhaven National Laboratory, October 1975).

Natural gas consumption in the commercial and industrial sectors can be calculated in the same manner; the relevant units then are "Number of Businesses/Institutions" and "Number of Industries". Both estimates should be adjusted by utility officials to reflect any differences between local and region-wide circumstances. This is especially important for the industrial sector where the regional average for customers and consumption may reflect large industries not found in the municipality. If the

differences between the region and the municipality are too great, this method may be invalid.

Natural gas consumption figures for the industrial sector can be cross-checked by using data from the report, Consumption of Fuel and Electricity by Ontario Manufacturing Industries, as a basis for deriving another estimate. This document, produced annually by the Ministry of Treasury and Economics, includes data on the quantity of natural gas used per employee by each S.I.C. Industrial Group. Scott's Directory of Manufacturers will provide information on the number of employees in each S.I.C. Group in the municipality. (Note, however, that the Directory may not include all local industries – only those who responded to Scott's invitation to be listed; use an alternative directory, as noted on page 44). Multiplying the two figures for each S.I.C. Industrial Group and summing the results generates another estimate of industrial sector natural gas consumption. An example follows.

S.I.C. Group	Natural Gas Required Per Employee (MCF)	No. of Employees	Total Natural Gas Required (MCF)
184 Twine Industry	14	200	2800
188 Automobile Fabric Accessories	51	400	20400
Sub-total			23200

Adding the estimates of natural gas consumption derived for each sector yields a new figure for "Total Community Natural Gas Consumption". The first and second estimates can now be adjusted, in consultation with natural gas utility officials, to reconcile any significant differences between them.

1.4.3 Heating Oil

Several estimating techniques probably will be required to arrive at "Total Community Heating Oil Consumption" and "Heating Oil Consumption by Sector".

At the outset, each heating oil distributor in the community should be contacted and asked to provide:

- Data on the number of customers served in each sector (residential, commercial, industrial).
- A figure (actual or estimated) for the total gallons of oil sold to customers in the municipality.
- An estimate of "average oil consumption" by house type in the residential sector (single-family detached, small apartments, large apartments,and row housing) and for commercial and industrial customers.

Some oil distributors will be able to respond adequately to the request for consumption by sector; most,

however, will not. Energy profiling will then have to resort to estimates.

To calculate "Total Heating Oil Consumed in the Community", add the figures received from each oil distributor. Where one or more oil distributor is unable or unwilling to provide such a figure, estimates of oil consumption by sector will have to be calculated in order to derive a "Total" consumption figure. The following approaches can be used to estimate oil consumption by sector.

Residential: First Estimate:

(i) Total number of households in the municipality − Households with electric space heating + Estimated number of households with natural gas heating

= Number of households with oil heating

Note: This assumes that "other" fuels are insignificant. Should this assumption be incorrect (where wood is a significant fuel, for example) the formula will have to be adjusted accordingly.

(ii) Estimated number of households with oil heating X Average oil consumption per household

= Oil consumption for residential sector

Residential: Second Estimate:

Percentage of households with oil home heating in the municipality	X	Number of households in the municipality	X	Average oil consumption per household

= Oil consumption for residential sector

Data on the percentage of households with oil home heating in the municipality are likely to be available from Ontario Hydro's Energy Application Survey; contact the municipal utility.

If local oil distributors are unable to provide an estimate of average oil consumption per household (or as a check on their estimate) use the energy intensity factors developed by Brookhaven National Laboratory, shown below:

Energy Intensity Factors For Oil Heated Homes
(million BTU/unit/year)

Single Family Detached	Single Family Attached	Low Rise	High Rise
151	106	92	72

Note:
These figures are based on 5500 heating degree days Fahrenheit. To adjust for climatic variations add, for every additional 1000 degree days per year:

14 Million BTU per 1000° days per year for single-family detached
12 Million BTU per 1000° days per year for single-family attached
10 Million BTU per 1000° days per year for low rise
7 Million BTU per 1000° days per year for high rise

Degree-day data for Ontario communities are available from Environment Canada, Atmospheric Environment Service (4905 Dufferin Ave., Downsview, Ontario M3H 3T4).

Source: T. Owen Carroll et al, Land Use and Energy Utilization. Interim Report (Upton, NY: Brookhaven National Laboratory, October 1975).

Commercial: First Estimate

(i) Total number of customers in municipality − Commercial customers with electric heating + Estimated number of commercial customers with natural gas heating

= Number of commercial customers with oil heating

(ii) Estimated number of commercial customers with oil heating X Average oil consumption per customer = Oil consumption for commercial sector

The "Number of Commercial Customers" can be obtained from municipal electric utility S.I.C. Statistics (since each business, institution and municipal office would use electricity for lighting, all commercial buildings would be counted in the S.I.C. Statistics). "Commercial Customers with Electric Heating" may be obtained from the municipal electric utility.
The "Estimated Number of Commercial Customers with Natural Gas Heating" will likely include commercial customers using natural gas for cooking and/or water heating only. The natural gas utilities are generally unable to separate their customers by end use but they should be able to assist in making the necessary estimate.

Note: because the commercial sector is so large and diverse, it requires special care in estimating energy consumption. One means of reducing the diversity is to obtain actual consumption figures (or estimates) from major institutional users or for entire subsectors.

Commercial: Second Estimate

The following approach assumes that data on commercial floor area (by subsector) are available from municipal records.

Calculate oil consumption for each subsector in the commercial sector and sum to obtain an overall estimate as follows:

(i) From municipal records determine the amount of oil consumed by the municipal corporation (in municipal buildings and in the provision of services) during the base year.

(ii) Conduct a survey of institutional building owners/managers to obtain a figure for oil consumed by the institutional subsector.

Data on oil consumed in schools may be available from local school boards.

Data on oil consumption in hospitals may be available from hospital administration officials.

Other institutional uses (such as provincial and federal government offices, public/cultural and recreational centres, churches and prisons) should be sample-surveyed to obtain an estimate of average oil consumption per square foot/metre. This figure can then be multiplied by the total floor area of institutional space in this category to obtain an overall estimate of oil consumed by "other institutions".

The sum of oil consumed in schools, hospitals and other institutions provides an estimate of oil consumed in the institutional subsector of the commercial sector.

(iii) To estimate oil consumed by businesses, conduct a sample survey to obtain a figure for average oil consumed per square foot/metre. Businesses should be surveyed by S.I.C. Groups: Food Stores, General Merchandise Stores, Service Stores, large hotels/motels (more than 160 rooms), small hotels/motels (less than 160 rooms), wholesale showrooms, and warehouses. Multiply the estimate of average oil consumed per square feet/metre by the floor space to obtain a figure for oil consumed in the business subsector.

Industrial: First Estimate

Quantity of Heating Oil Used Per Employee by S.I.C. Industrial Group X Number of Employees in each S.I.C. Industrial Group in the Municipality

= Estimated Oil consumption in the Industrial Sector

Data on the quantity of heating oil used per employee by S.I.C. Group are available in Consumption of Fuel and Electricity by Ontario Manufacturing Industries published annually by the Ministry of Treasury and Economics.

Use Scott's Directory of Manufacturers or an alternative directory (see note on page 44) to determine number of employees in each S.I.C. Industrial Group in the municipality.

Industrial: Second Estimate

Conduct a survey of industries within S.I.C. Groups in the municipality and ask for total oil consumption; alternatively, request an estimate of oil used per employee and the number of employees.

1.4.4 Gasoline

Calculate gasoline consumed by the municipal fleet for the base year using available municipal records. Public transit, where it exists, may be included under "municipal fleet" or it can become a separate subsector.

To estimate the amount of gasoline consumed by private vehicles in the community, several techniques should be used, each as a check on the others.

Gasoline: First Estimate

Here, gasoline consumption is calculated on the basis of the amount of travel by local residents and fuel economy estimates.

$$\frac{\text{Number of vehicles in the municipality} \times \text{Average miles or kilometres driven per vehicle per year}}{\text{Average miles per gallon or kilometres per litre}} = \text{Gallons or litres of gasoline consumed}$$

A total vehicle count based on vehicle registrations can be obtained from the Licensing and Control Branch of the Ministry of Transportation and Communications. Note that vehicle registrations may not equal actual number of vehicles in use in the community.

If records are being kept of fuel consumed by the municipal fleet, separate municipally-owned vehicle registrations from other vehicles in the community; then add the municipal fleet fuel consumption figure (which will be used again in Step 1.6) to the estimate of private automobile fuel consumption.

A recent Statistics Canada survey indicates that the average passenger vehicle in Ontario gets 10 miles per gallon (or 6.4 km/L) and that the yearly mileage per passenger car in use in Ontario is 9,875 miles or 15,800 km (see chart below). This figure can be adjusted up or down to reflect local driving patterns (e.g., data may be available from a recent land use transportation study in the local area). The Ontario Ministry of Transportation and Communications also has data available on total vehicle kilometres or miles traveled by the automobile fleet in various regions and municipalities of Ontario; these data can be used to adjust the Ontario average figure. Contact: Transportation Energy Management Program, MTC, phone (416) 248-7296.

ONTARIO PASSENGER CAR FUEL CONSUMPTION SURVEY
July 1979 to June 1980

Data Collected	July to Sept.	Oct. to Dec.	Jan. to Mar.	April to June	Overall Average
Passenger Cars Operated	2,667,800	2,849,600	2,755,900	2,749,000	2,755,575
Fuel Consumed (thousands of litres)	1,986,230	2,000,060	1,766,463	1,747,839	
Total km Traveled	13,369,136	11,992,875	9,544,456	11,489,084	
L/100 km	14.1	16.1	18.3	15.0	15.8
MPG	20.1	17.6	15.5	18.9	18.0
km/L	7.1	6.2	5.5	6.7	6.4
Average km Driven Per Day	N/A	46	38	46	43.3
Average km Driven Per Year					15,804.5

Source: Statistics Canada, Passenger Car Fuel Consumption Survey (Ottawa: Statistics Canada, Education, Science and Culture Division, Special Surveys Group).

The estimate of fuel consumption derived in the above approach is only a crude indication of gasoline use in the community. One way of improving this estimate is to calculate fuel consumed by vehicle type, differentiated by cylinder size and two age groups (pre-1975 and after 1975, when fuel economy standards improved.) The Ministry of Transportation and Communications can provide vehicle registration figures by vehicle type. There is a charge for this service;

for cost estimates contact MTC, Services Division, Co-ordinator of Vehicle Systems, (416) 248-3071. If these data are obtained the following calculation can be made (if possible, adjust the Ontario average miles-traveled figure to reflect local driving habits):

$$\frac{\text{Number of 4-cylinder cars, pre-1975} \times 9875 \text{ miles}}{25\text{mpg}} = \text{Gallons of gasoline consumed}$$

$$\frac{\text{Number of 4-cylinder cars, 1975-} \times 9875 \text{ miles}}{30\text{mpg}} = \text{Gallons of gasoline consumed}$$

$$\frac{\text{Number of 6-cylinder cars, pre-1975} \times 9875 \text{ miles}}{17\text{mpg}} = \text{Gallons of gasoline consumed}$$

$$\frac{\text{Number of 6-cylinder cars, 1975-} \times 9875 \text{ miles}}{22\text{mpg}} = \text{Gallons of gasoline consumed}$$

$$\frac{\text{Number of 8-cylinder cars, pre-1975} \times 9875 \text{ miles}}{12\text{mpg}} = \text{Gallons of gasoline consumed}$$

$$\frac{\text{Number of 8-cylinder cars, 1975-} \times 9875 \text{ miles}}{16\text{mpg}} = \text{Gallons of gasoline consumed}$$

TOTAL FOR ALL TYPES OF VEHICLES = Gallons of gasoline consumed

Note: The mpg estimates in the above formulae represent average combined miles per gallon as calculated by the U.S. Environmental Protection Agency; they have been converted to Imperial Gallons.

The foregoing calculations will provide rough estimates of gasoline consumed by private automobiles and the municipal fleet but not for the transportation sector as a whole. To derive a "Total" consumption figure the following adjustment should be made to include trucks. A recent study

of urban goods movement in Metropolitan Toronto estimated that percentage share of urban road fuel demand is 87% for automobiles and 13% for trucks. (See: Gene Desfor and Lawrence Haas, Energy Requirements for Urban Goods Movement. Toronto: University of Toronto/York University Joint Program in Transportation, Research Report No. 60, April 1979, Table 7). The following formula provides for the necessary adjustment:

$$\text{Total gasoline consumption} = \text{private automobile estimate} \times \frac{100}{87}$$

Gasoline: Second Estimate

Statistics Canada publishes data on passenger car fuel consumption and fuel sales in each province (see Passenger Car Fuel Consumption Survey and Road Motor Vehicles – Fuel Sales, described under 1.1.4 Gasoline, above). On the assumption that gasoline consumption is similar across the province (an acceptable assumption for purposes of rough estimation), these data can be used to estimate gasoline consumption in the community as follows:

$$\frac{\text{Local population}}{\text{Provincial population}} \times \text{Provincial gasoline sales} = \text{Local gasoline sales (gallons)}$$

Municipalities in Metro Toronto can make use of another Statistics Canada publication, the Petroleum Statistics Quarterly (discontinued since 1978), which provided data on gasoline sales for their area. They can estimate gasoline sales using the formula shown below:

$$\text{Metro Toronto retail gasoline sales 1977-78} \times \frac{\text{Population of municipality (1975)}}{\text{Metro Toronto population (1978)}}$$

= Retail gasoline sales for municipality, 1978

To adjust this estimate to the base year (say 1980) multiply by the proportional increase in motor vehicles in the municipality between Statistics Canada survey date and the base year.

Gasoline: Third Estimate

The Ontario Ministry of Transportation and Communications has developed a technique for estimating energy consumption in urban areas (100,000 population and over). It involves totaling fuel consumed over all city streets:

$$\text{Fuel Consumption (in litres)} = \frac{[100.4(D) + 0.63\ (T) \times (N)]}{1000}$$

where D = total travel distance in kilometres
T = total travel time in seconds
N = number of vehicles

Arterial Streets:

(a) 40 km with an AADT (average annual daily traffic) of 24000 and an average operating speed of 50 km/h (total travel time 2880 seconds):

$$\text{Fuel Consumption (per day)} = \frac{[100.4(40) + 0.63(2880)] \times (24000)}{1000}$$

$$= 139920 \text{ L}$$

(b) 80 km with an AADT of 20000 and an average operating speed of 40 km/h (total travel time 7200 seconds)

$$\text{Fuel Consumption (per day)} = \frac{[100.4(80) + 0.63(7200)] \times (20000)}{1000}$$

$$= 251360 \text{ L}$$

(c) 40 km with an AADT of 15000 and an average operating speed of 30 km/h (total travel time 4799 seconds)

Fuel Consumption (per day) = 105590 L

Collector Streets

80 km with an AADT of 10000 and an average operating speed of 25 km/h (total travel time 11520 seconds)

Fuel Consumption (per day) = 152986 L

Local Streets

200 km with an AADT of 1800 and an average operating speed of 25 km/h (total travel time 14400 seconds)

Fuel Consumption (per day) = 52473 L

TOTAL DAILY FUEL CONSUMPTION = 702239 L

Source: IBI Group, Traffic Management Measures to Reduce Energy Consumption (Toronto: Ministry of Transportation and Communications, Transportation Energy Management Program, Nov. 1981), p. 5.

Step 1.5 Summarize Totals and Adjust as required to Obtain Overall Estimate for the Community in the Base Year

For each fuel and sector, the results of the "best estimate" calculated in Step 1.4 should be recorded on Worksheet 2: Energy Consumption by Fuel and Sector. Adjustments may be necessary to arrive at a common total in the lower right-hand corner of the matrix.

At this point the first community-wide picture of energy consumption emerges. It is useful to pause and consider whether the estimates that have been made are "in the right ballpark". For this purpose, check the percentages of total community consumption by fuel and sector against provincial averages and profiles that have been completed for other communities. Where large anomalies show up, they need to be explained (e.g., harsh winter, local industry mix, unique commuting patterns, etc.).

SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU*	MMCF	BTU*	Gal.	BTU*	Gal.	BTU*	BTU*	% of Total
Residential										
Commercial										
Industrial										
Transportation										
Total BTU*										
% of Total										

* or Joules

WORKSHEET 2 ENERGY CONSUMED BY FUEL AND SECTOR

Step 1.6 Determine Energy Consumption for Selected Subsectors in the Base Year

Eleven subsectors are analyzed in a typical first-round community energy profile. This list can be expanded or reduced depending on the availability of data and other local considerations (Step 0).

Sectors	Selected Subsectors
Residential	Single-Family Detached
	Small Apartments
	Large Apartments
	Row Housing
Commercial	Municipal Buildings
	Municipal Services
	Institutional
	Businesses
Transportation	Municipal Fleet
	Private Vehicles

For some fuels and sectors, Step 1.6 is fairly straightforward since Step 1.4 already involved the collection of data for some subsectors. Calculation procedures are set out below by fuel type. Use Worksheet 3 to record the results.

1.6.1 Electricity

Electrical energy consumption by subsector can be easily derived from the S.I.C. Quarterly Statistics on file with Ontario Hydro Regional Offices. Utility officials may provide assistance in identifying the S.I.C. Groups for each subsector.

1.6.2 Natural Gas

Municipalities in the areas served by Union Gas or municipal gas utilities can obtain data on gas consumption by subsector (contact the head office at the address provided under Step 1.1). All other municipalities will have to estimate natural gas consumption by subsector using the following techniques:

Residential: First Estimate

Ask local gas utility officials to estimate the number of customers in each subsector and average gas consumption by subsector (gas utility officials may prefer to estimate for two subsectors only - single-family and apartments). Use these estimates to obtain figures for natural gas consumption by subsector.

Residential: Second Estimate

Ontario Hydro's Energy Application Survey provides data on the proportion of the community's single-family houses and apartments that use natural gas for space heating, water heating and cooking. (Contact the municipal utility; if your municipal utility did not participate in the survey, contact Ontario Hydro or Hydro's regional office and use data available for the region as a basis for estimating the percentage of houses in your municipality using natural gas.) To estimate natural gas consumption for these two subsectors use the following formulae:

% of single-family houses consuming natural gas X Number of single-family houses in the municipality X Average natural gas consumption for single-family houses

= Total natural gas consumption for single-family sub-sector

% of apartments consuming natural gas X Number of apartments in the municipality X Average natural gas consumption for apartments

= Total natural gas consumption for apartment sub-sector

Adjust these subsector estimates to match the estimate of gas consumption for the residential sector as a whole.

Commercial Estimate

Use the "Second Estimate" technique in Step 1.4.3.

1.6.3 Heating Oil

Residential: First Estimate

Ask local oil distributors to estimate the number of customers in each subsector and average oil consumption by subsector (oil distributors may prefer to estimate for two subsectors only – single-family and apartment). For each subsector, combine these estimates to obtain a figure for heating oil consumption.

Residential: Second Estimate

Ontario Hydro's Energy Application Survey provides data on the percent of single-family homes and apartments in the municipality that use oil for space heating and

water heating. (Contact the municipal utility; if your municipal utility did not participate in the survey, contact Ontario Hydro or Hydro's regional office and use data available for the region as a basis for estimating the percentage of houses in your municipality using natural gas.)

To estimate oil consumption for these two subsectors use the following formulae:

% of single family houses consuming oil in the municipality	X	Number of single-family houses in the municipality	X	Average oil consumption for single-family houses

= Total heating oil consumption for single-family subsector

% of apartments consuming oil	X	Number of apartments in the municipality	X	Average oil consumption for apartments

= Total heating oil consumption for apartment subsector

Adjust these subsector estimates to match estimate of oil consumption for the sector as a whole.

Commercial Estimate

Use the Second "Estimate" technique, Step 1.4.3.

1.6.4 Gasoline

Step 1.4.4 involved the calculation of gasoline consumption for two subsectors (Municipal Fleet and Private Vehicle).

Record the results of Step 1.6 on Worksheets 3, 3a, 3b and 3c.

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION				
	Electricity BTU	Natural Gas BTU	Heating Oil BTU	Gasoline BTU	Total BTU
RESIDENTIAL					
s.f.dwelling					
sm. apt.					
lg. apt.					
row					
COMMERCIAL					
mun. bldg.					
mun. serv.					
Inst.					
Bus.					
TRANSPORTATION					
mun. fleet					
auto					
other					
TOTAL					

WORKSHEET 3 ENERGY CONSUMED BY SUBSECTOR: SUMMARY (complete Worksheets 3a, 3b, 3c first)

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU	MMCF	BTU	Gal.	BTU	Gal.	BTU	BTU	% of Total
Residential (overall)										
Single-Family Detached										
Small Apartment (multiplex; 5-6 units of less)										
Large Apartment (over 5-6 units)										
Town/Row Housing										

WORKSHEET 3a ENERGY CONSUMED BY SUBSECTOR: RESIDENTIAL

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU	MMCF	BTU	Gal.	BTU	Gal.	BTU	BTU	% of Total
Commercial (overall)										
Municipal Buildings										
Municipal Services										
Institutional										
Businesses										

WORKSHEET 3b ENERGY CONSUMED BY SUBSECTOR: COMMERCIAL

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU	MMCF	BTU	Gal.	BTU	Gal.	BTU	BTU	% of Total
Transportation (overall)										
Municipal Fleet										
Automobiles										
Other										

WORKSHEET 3c ENERGY CONSUMED BY SUBSECTOR: TRANSPORTATION

Step 1.7 Determine Energy Consumption for Selected End Uses in the Base Year

Ten end uses in two sectors, those for which data are more readily available and which municipalities are best able to influence, may be analyzed in a Round 1 profile. This list can be expanded or reduced depending on available resources and other local considerations (determined in Step 0).

Sectors	Selected Subsectors	Selected End Uses
Residential	Single-Family Detached	Space Heating
	Small Apartments*	Space Cooling
	Large Apartments*	Water Heating
	Row and Town Houses	Other Uses
Commercial	Municipal Buildings	Space Heating
	Municipal Services	Space Cooling
	Other Institutional	Water Heating
	Businesses	Lighting and Other Uses
		Street Lighting
		Sewage Treatment and Water Supply

* defined in Step 1.3

End use energy consumption can be calculated for each sector as a whole and/or for each subsector. Availability of data and other considerations will determine the kinds of calculations that can be made. Use Worksheet 4 to record the results.

Step 1.7.1 Electricity

Residential electrical energy consumption by end use can be calculated using data available in the S.I.C. Quarterly Statistics. For this information contact the municipal utility or, if your community is not served by a municipal utility, Ontario Hydro's Regional Office.

Commercial electrical energy consumption by end use is best approached on a subsector basis, as follows:

Municipal Buildings. Electricity consumed in municipal buildings for space heating, space cooling, water heating and other end uses, can be calculated from municipal corporation records or data available from the municipal utility.

Municipal Services. Data on electricity consumed for street lighting are available in Ontario Hydro's Statistical Yearbook. To estimate electrical energy consumption for sewage treatment and water supply, use the following figures derived from an Ontario Hydro Study, End Uses of Electricity in the Commercial Market of Ontario (Marketing Research and Statistics Division, 1976):

Water supply - 435 kwh per household

Sewage treatment - 174 kwh per household

Institutions and Businesses. Municipal electric utility officials should be able to provide an estimate of the amount of electricity these two subsectors consumed for space heating, space cooling, water heating, and lighting and other uses. If possible, for the institutional subsector combine lighting and other uses; for the businesses subsector keep them separate (in order to obtain an indication of energy consumed for commercial lighting).

Step 1.7.2 Natural Gas

Data on end use consumption of natural gas by subsector are generally not available. To estimate end use in the residential sector, use data from Ontario Hydro's Energy Application Survey on the percentage of gas space heaters, water heaters and other appliances in each municipality or Ontario Hydro region (contact the municipal utility or the regional office):

% of gas space heaters X Number of households in the municipality X Average gas consumption for space heating

= Gas consumed for space heating

% of gas water heaters X Number of households in the municipality X Average gas consumption for water heating

= Gas consumed for water heating

% of gas ranges and clothes dryers	X	Number of households in the municipality	X	Average gas consumption for such appliances

= Gas consumed for other uses

When the 1981 Census becomes available it will provide a more accurate estimate of the number of houses in the municipality using gas for space and water heating.

Contact the natural gas utility in your area for an estimate of average gas consumption for space heating, water heating, and cooking and clothes drying.

Natural gas consumption by end use in the commercial sector can be estimated using the "Second Estimate" technique set out in Step 1.6.3.

Step 1.7.3 Oil

Oil consumption data on end use by subsector are generally not available. End use in the residential sector can be estimated using data available in Ontario Hydro's Energy Application Survey, as follows:

(i) % of households in the municipality or Ontario Hydro Region with oil water heaters X Number of households in the municipality X Average oil consumption per household for water heating

= Amount of oil consumed for water heating

(ii) Total residential oil consumption (Step 1.4) − Estimate of oil consumed for water heating = Amount of oil consumed for space heating

When the 1981 Census data become available they will provide a more accurate estimate of the number of houses in the municipality with oil space and water heaters. Local oil distributors should be able to provide an estimate of the average consumption per household for water heating.

End use in the commercial sector can be estimated using the "Second Estimate" technique set out in Step 1.6.3.

Summarize the results of Step 1.7 using Worksheets 4, 4a and 4b.

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION				
	Electricity BTU	Natural Gas BTU	Heating Oil BTU	Gasoline BTU	Total BTU
RESIDENTIAL					
Space Heating					
Space Cooling					
Water Heating					
Lighting & Other Uses					
COMMERCIAL					
Space Heating					
Space Cooling					
Water Heating					
Lighting & Other Uses					

WORKSHEET 4 ENERGY CONSUMPTION BY END USE: SUMMARY (see also Worksheets 4a and 4b)

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU	MMCF	BTU	Gal.	BTU	Gal.	BTU	BTU	% of Total
S.F. DETACHED										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										
SMALL APARTMENT										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										
LARGE APARTMENT										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										
TOWN/ROW HOUSES										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										

WORKSHEET 4a ENERGY CONSUMPTION BY END USE: RESIDENTIAL SUBSECTORS

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION									
	Electricity		Natural Gas		Heating Oil		Gasoline		Total	
	kwh	BTU	MMCF	BTU	Gal.	BTU	Gal.	BTU	BTU	% of Total
MUN. BUILDINGS										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										
MUN. SERVICES										
sw. treatment										
st. lighting										
garb. coll.										
water supply										
INSTUTIONAL										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										
BUSINESS										
sp. heating										
sp. cooling										
w. heating										
lgt. & other										

WORKSHEET 4b ENERGY CONSUMPTION BY END USE: COMMERCIAL SUBSECTORS

Step 1.8 Determine Total Costs of Energy to the Community in the Base Year

Each of the energy suppliers serving the community should be able to provide cost-related information. Annual reports for the municipal electric utility and Ontario Hydro's Statistical Yearbook will provide information on the sales of electricity (in dollars) to the community as a whole and to each sector. Note that the commercial and industrial sales figures may be combined; however, it should not be difficult for utility officials to provide separate figures for each.

Similarly, sales figures by sector should be available in the annual reports of the natural gas companies. For heating oil, unit costs prevailing during the base year are readily available (see Section 4). This also applies to gasoline but some adjustments will be required to reflect variations in prices of different grades of gasoline (see Section 4).

Summarize cost estimates in Worksheet 5.

SECTOR AND SUB-SECTOR	ENERGY CONSUMPTION								
	Electricity		Natural Gas		Heating Oil		Gasoline		Total
	Unit Cost	Total	Unit Cost	Total	Unit Cost	Total	Unit Cost	Total	
RESIDENTIAL									
s.f.dwelling									
sm. apt.									
lg. apt.									
row/town h.									
sp. heating									
sp. cooling									
w. heating									
lgt. & other									
COMMERCIAL									
mun. bldgs									
mun. serv.									
institutional									
businesses									
sp. heating									
sp. cooling									
w. heating									
sw. treatment									
lgt. & other									
INDUSTRIAL									
TRANSPORTATION									
mun. fleet									
automobile									
other									

WORKSHEET 5 COSTS OF ENERGY CONSUMED

Step 1.9 Identify Any Special Features of Local Energy Use Patterns

The preceding steps estimated energy consumed in the community as a whole, in each sector, ten subsectors, and for ten end uses. Certain other aspects of the community's energy consumption may also warrant examination. Two examples include:

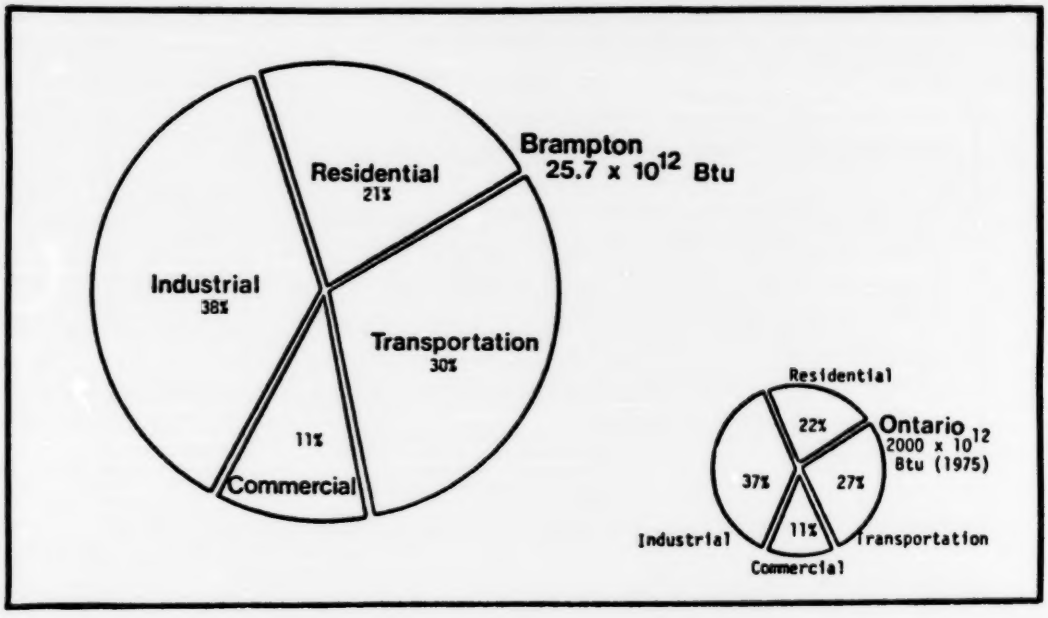
- Climate. Unusually mild or severe weather in the base year needs to be taken into account when reaching conclusions.
- Peaking Patterns. Has the municipal electric utility been experiencing load management problems due to peaks in energy consumption? When is the consumption of oil and natural gas the greatest?

Step 1.10 Summarize Current Local Energy Use in Both Energy Units and Dollars

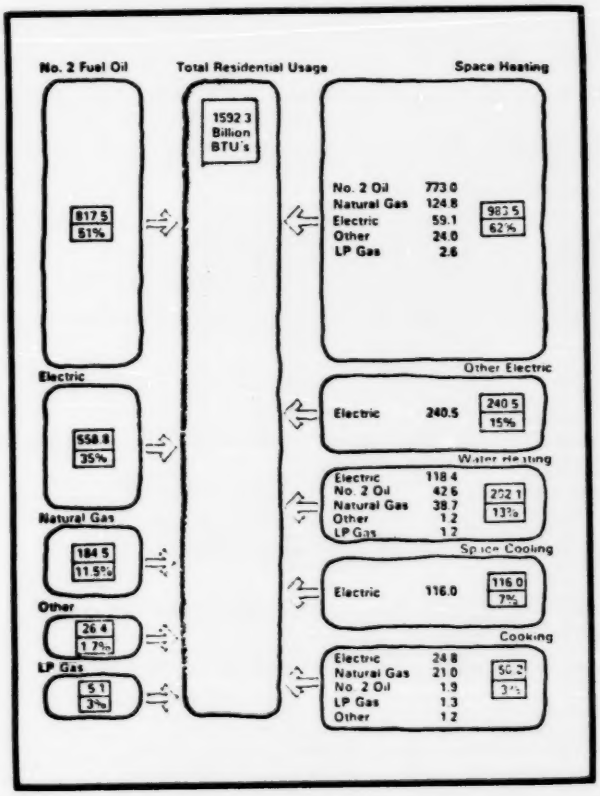
Prepare an overall summary of community energy use that describes total energy consumed and costs by fuel for: a. the community as a whole; b. each sector; c. each/subsector; d. end use by sector and subsector; and e. end use overall. The description of total energy consumption can include such indicators as per capita energy consumption (for the community as a whole), per household energy consumption (for the residential sector), per square foot of space (for the commercial sector), and per employee (for the commercial and industrial sectors). Round off the totals to reflect the level of accuracy in the data themselves and as required to support ensuing arguments.

The results of the energy profile must be presented in a form that can be easily understood by other municipal officials, elected decision-makers, energy suppliers, business and industry people, the media and local residents. A common way to communicate energy profile data is in the form of "energy pies" and "spaghetti charts", illustrated on the next two pages. The latter should be used carefully since they may confuse the reader.

1980 Energy Consumption By Sector



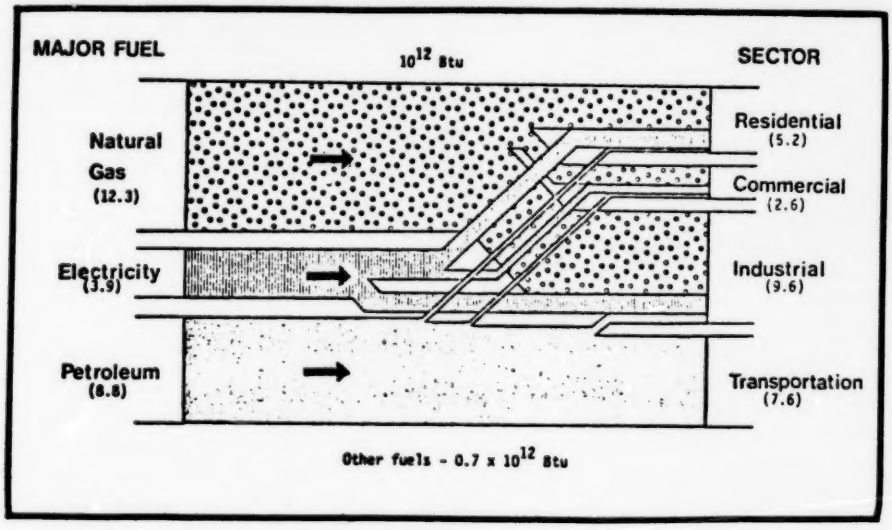
Source. Brampton Energy Profile



Residential Energy Sources and End Uses

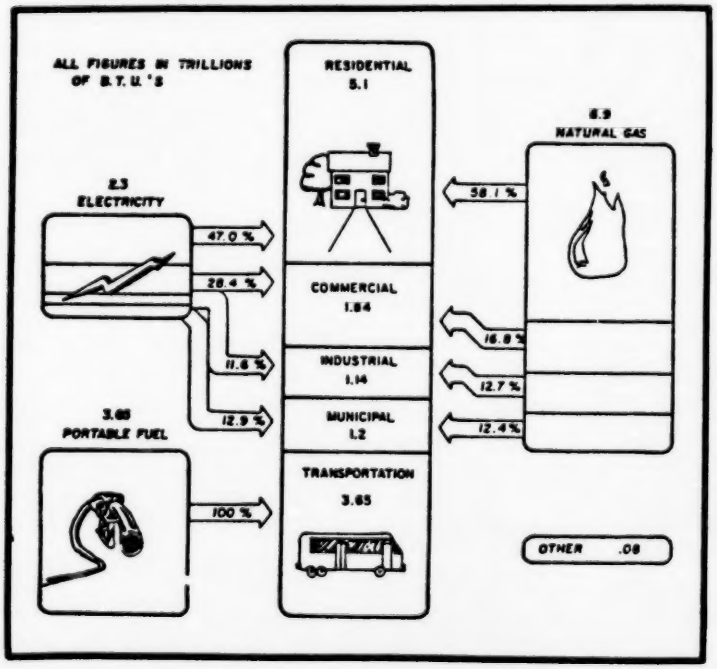
Source: Greenville Energy Program

Overall Energy Use In Brampton 1980

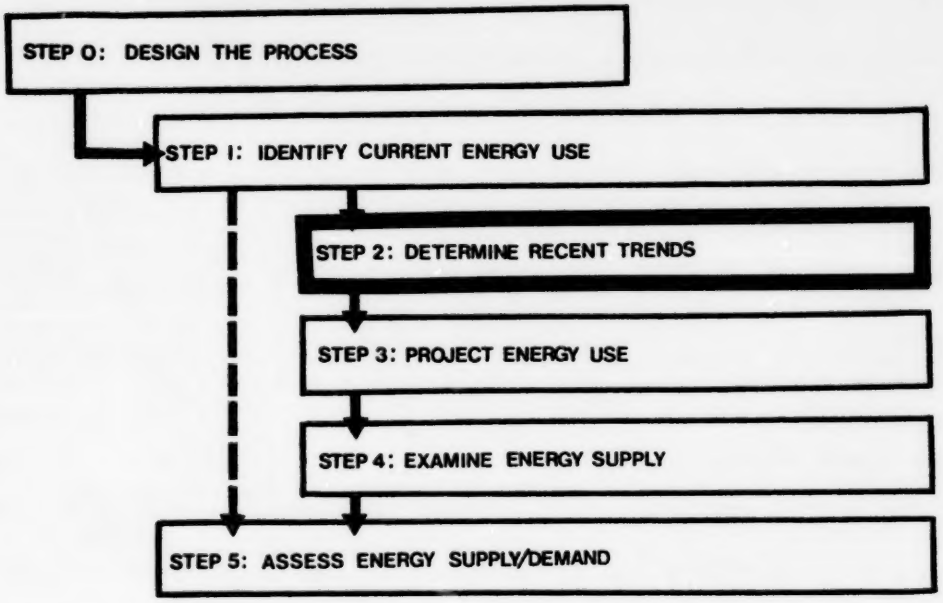


Source: Brampton Energy Profile

Energy Flows, Boulder, CO, 1978



Source: Boulder Community Energy Management Plan


STEP 0: DESIGN THE PROCESS
STEP 1: IDENTIFY CURRENT ENERGY USE
STEP 2: DETERMINE RECENT TRENDS
STEP 3: PROJECT ENERGY USE
STEP 4: EXAMINE ENERGY SUPPLY
STEP 5: ASSESS ENERGY SUPPLY/DEMAND

Step 2: Determine Recent Trends

Objective: to identify recent changes in the community's energy consumption pattern.

Step 1 provides a static, one-point-in-time snapshot of local energy consumption. It is also useful to know whether current levels of energy use represent an upward or downward trend or are unchanged. An analysis of recent community energy consumption will assist in assessing the dimensions of the local energy problem, in making projections about future energy consumption levels, and in determining how vigorous the energy management program should be. For

example, a community where fuel oil consumption is on the increase has a potentially more serious energy problem and may require a more aggressive energy management strategy than one that has been experiencing a steady reduction in fuel oil use.

Step 2, essentially a repeat of Step 1, involves four sub-steps.

Step 2.1 Select Earlier Year(s)

There are no hard and fast guidelines regarding which years to select for analysis. Data availability is one obvious constraint that should be investigated. Generally, an analysis of recent trends is more likely to be effective if:

a. two or more years are selected. An analysis of only one earlier year may not provide a reliable or credible indication of energy consumption trends.

b. one of the years is 1973 or just before. After 1973 the wholesale price of energy rose sharply; therefore, a noticeable difference could be expected between pre-1973 and post-1973 levels of consumption. A comparison of energy consumption in these two periods, coupled with an analysis of energy cost trends (coming up in Step 2.2), will

indicate the extent to which the community is responding to increasing energy prices. Community trends can also be compared with overall provincial trends and those experienced by other places (addressed again in Step 5).

Step 2.2 For Each Earlier Year Selected, Determine Fuel Consumption by Sector and Fuel Type and, if Appropriate, by Designated Subsectors and End Uses

Use the methods and estimating techniques set out in Step 1. In some cases, data availability problems will dictate the use of methods different from those used to calculate energy consumption in the base year. Communities served by Union Gas, for example, will find that municipality-specific data on gas consumption are not available before 1979; they will have to rely on estimating techniques rather than secondary data.

Step 2.3 For Each Earlier Year Selected, Determine Costs of Energy to the Community, in Constant and Current Dollars

Representative energy prices by sector can be obtained from the municipal electric utility or Ontario Hydro, the natural gas company and fuel oil distributors. Comparative information on province-wide energy prices are available from the Ontario Ministry of Energy.

Step 2.4 Summarize Trends in Local Energy Use and Costs

Use Worksheet 6 to summarize local trends. The addition of charts and graphs comparing trends in local energy use and costs with changes (over the same period) in average personal disposal income per capita or per household may further help to explain the community's energy consumption pattern.

	ENERGY CONSUMPTION							
	FUELS				SECTORS			
	Electricity BTU	Natural Gas BTU	Heating Oil BTU	Gasoline BTU	Residential	Commercial	Industrial	Transportation
Base Year 19___								
Previous Years 19___								
19___								

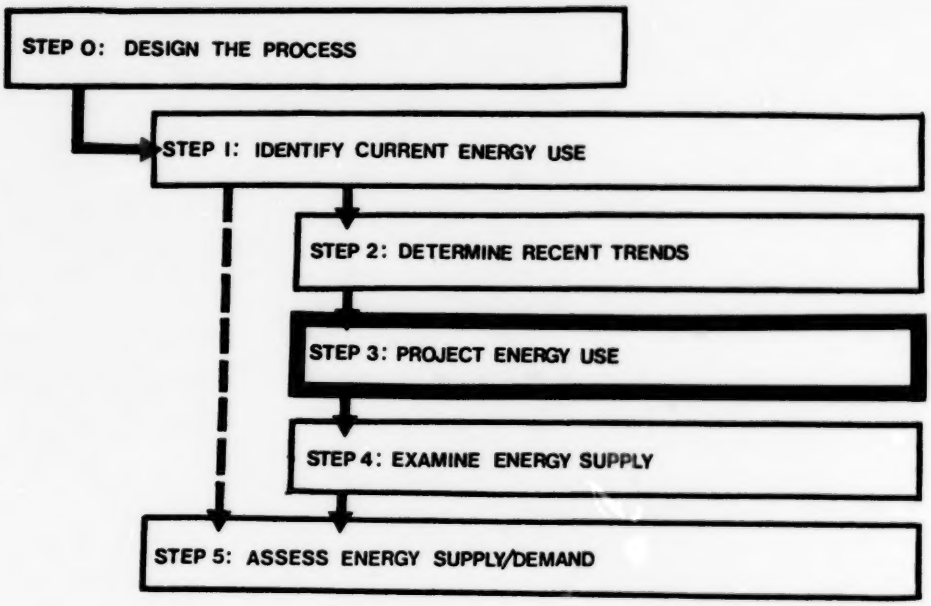
Per Capita Energy Consumption
Base Year 19___
Previous Years 19___
19___

Per Square Foot Commercial Space Energy Consumption
Base Year 19___
Previous Years 19___
19___

Per Household Energy Consumption
Base Year 19___
Previous Years 19___
19___

Per Employee Energy Consumption
Base Year 19___
Previous Years 19___
19___

WORKSHEET 6 RECENT TRENDS IN ENERGY CONSUMPTION


STEP 0: DESIGN THE PROCESS
STEP 1: IDENTIFY CURRENT ENERGY USE
STEP 2: DETERMINE RECENT TRENDS
STEP 3: PROJECT ENERGY USE
STEP 4: EXAMINE ENERGY SUPPLY
STEP 5: ASSESS ENERGY SUPPLY/DEMAND

Step 3: Project Energy Use

Objective: to consider the community's energy supply/demand future and the implications it holds for present energy decisions.

Projections of any kind raise problems. Energy-related forecasts are especially difficult because of uncertainties surrounding supply, consumer response to energy problems, government intervention and private sector initiatives. Despite these constraints, projections of future energy consumption and costs in the community are often worthwhile (energy supply projections tend to be less valuable). Such

projections may reveal further dimensions of the local energy problem, guide the setting of time horizons for needed sequences of action, and help motivate decision-makers and energy consumers. Projections can also provide an indication of "the unconstrained future" – what is likely to happen without municipal intervention (e.g., more fuel- efficient automobiles).

Step 3.1 Select Target Year(s)

The Ontario Ministry of Energy has developed projections of secondary energy consumption for the industrial, transportation, residential and commercial sectors using the years 1990 and 2000 as targets (see Ontario Energy Review). Basing projections of local energy use and costs on these same years has the advantage of allowing comparisons with provincial estimates.

Step 3.2 Project Community Energy Use

Projections of the community's energy consumption, overall and by fuel type and sector (and, where deemed appropriate, by subsectors and end uses), can be made using the following methods:

a. Project community energy consumption based on an assumed local share, proportional to population,

of projected provincial consumption. Provincial projections are summarized in the Ontario Energy Review; more detailed information can be obtained from the Ministry of Energy.

b. Project community energy consumption based on local trends identified in Step 2. While this can be a simple straight-line projection, a more reliable estimate of future energy use involves adjusting this projection to take account of developmental forecasts (population, employment, disposable income, housing starts, etc.). Each of these factors will influence the rate of growth of future secondary energy consumption.

c. Consult with local electric utility officials, gas and oil distributors, Ontario Hydro officials and head office representatives of the major gas and oil companies to obtain their projections of local energy supply and demand as well as opinions regarding possible gaps. For example, do they foresee a need for base load improvements? Do they foresee any serious constraints in meeting the projected demand?

Each of the foregoing methods should be used. They provide checks against each other and assist in arriving at a "best-guess" projection. Trend analysis alone, for

example, has been shown to be an unreliable basis for estimating future energy consumption at the local level; future consumption patterns at the local level are largely influenced by exogenous factors such as fuel price and provincial or federal government policies.

Step 3.3 Project Energy Cost to the Community

The aim here is to draw attention to the probable rate of increase in energy required by the community, and the implications for the community's economic wellbeing as well as for the individual's budget. Information on energy prices is available in the Ontario Energy Review; further data can be obtained from Ontario Hydro (i.e., forecasted averages for future rate increases), the Ministry of Energy, and oil and gas companies.

The schedule of oil and natural gas prices contained in the 1981 Ottawa/Alberta agreement can be used as a basis for projections (with some judgement applied to take account of current trends in world oil prices). It should be noted, however, that the oil companies are not *required* to increase their prices at the rates set out in the schedule; if concerned about the loss of customers due to substitution to natural gas or electricity, they may elect to keep oil prices low in some parts of the province. Consultation with

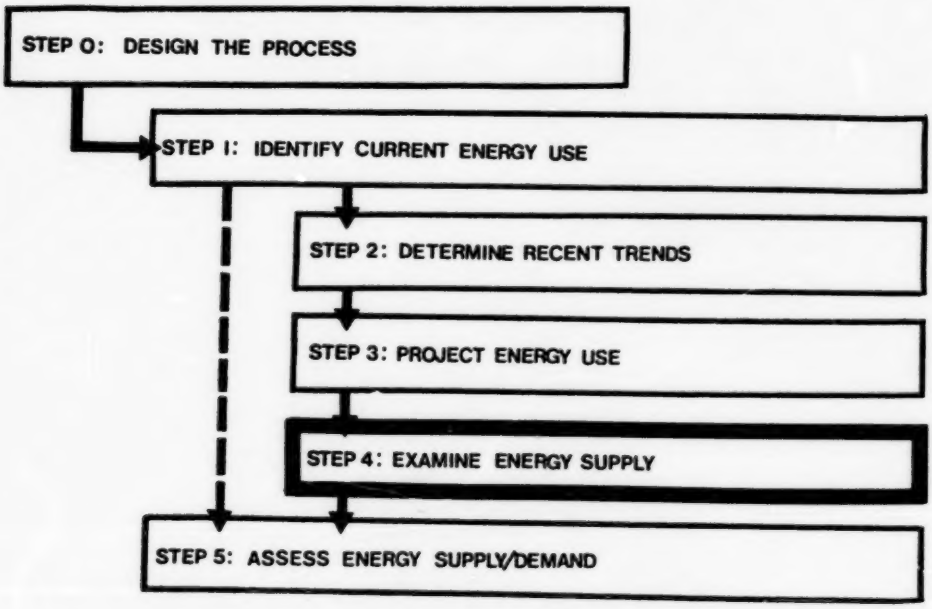
the major oil and gas company representatives in your area may uncover whether such action is likely.

Step 3.4 Summarize Projections

Use Worksheet 7 to summarize projected local energy use and costs.

	ENERGY CONSUMPTION							
	FUELS				SECTORS			
	Electricity BTU	Natural Gas BTU	Heating Oil BTU	Gasoline BTU	Residential BTU	Commercial BTU	Industrial BTU	Transportation BTU
Base Year 19___								
Local Share of Projected Provincial Consumption 1990								
2000								
Projected Local Trends 1990								
2000								
Projections by Local Utility Officials								

WORKSHEET 7 PROJECTED COMMUNITY ENERGY USE


STEP 0: DESIGN THE PROCESS
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Step 4: Examine Energy Supply

Objective: to present the supply side of the local energy situation — where the energy now comes from and whether alternative energy resources are available locally.

Municipalities too often assume that energy supply is the responsibility of provincial/federal governments and the energy industry, and therefore lies outside municipal control. While this is mostly true, opportunities do exist for municipal governments to affect the supply side. These

include protecting local energy resources, exploiting alternative sources to produce more energy locally, and assuring that community considerations are taken into account in the planning and timing of new energy supply facilities.

Step 4.1 Describe the Local Energy Supply System

This involves presenting a clear picture that shows where the community's energy comes from – heating oil, natural gas, electricity, gasoline, etc. – and how it is distributed locally. Part of the required data will have been gathered in Step 1; the remainder should be readily available from the energy utilities. Include energy facilities that are proposed or planned, together with any local energy supply problems (e.g., difficulty finding a suitable transformer site).

Step 4.2 Describe Relevant Planning Processes Affecting Community Energy Supply

How are energy supply decisions reached? For example, what is the planning process concerning the sizing, location and timing of construction of local electric transformer stations? How are energy prices set? To what extent does the community have or need to have input to these decisions? How much lead time is required? The answers should be

available from the energy utilities and the Ministry of Energy.

Step 4.3 Inventory Local Energy Resources

Conduct an inventory (at a first-cut level in Round 1) of local energy resources including those not now being exploited. Main categories are:

Biomass. This includes forest and woodlots as sources of firewood, wood waste from the forest industry, peat, agricultural crops and the prime foodlands on which they are or included and agricultural waste. Biomass also encompasses municipal solid waste (Ontario Energy Review, 1981, summarizes municipal solid waste projects in Ontario) together with biogas (especially methane) from sewage treatment and sanitary landfill.

Waste heat potentially recoverable from industries and power generation projects.

Solar. Although solar energy levels vary across the province, all areas have some potential for the application of passive and perhaps active solar systems, especially for space heating.

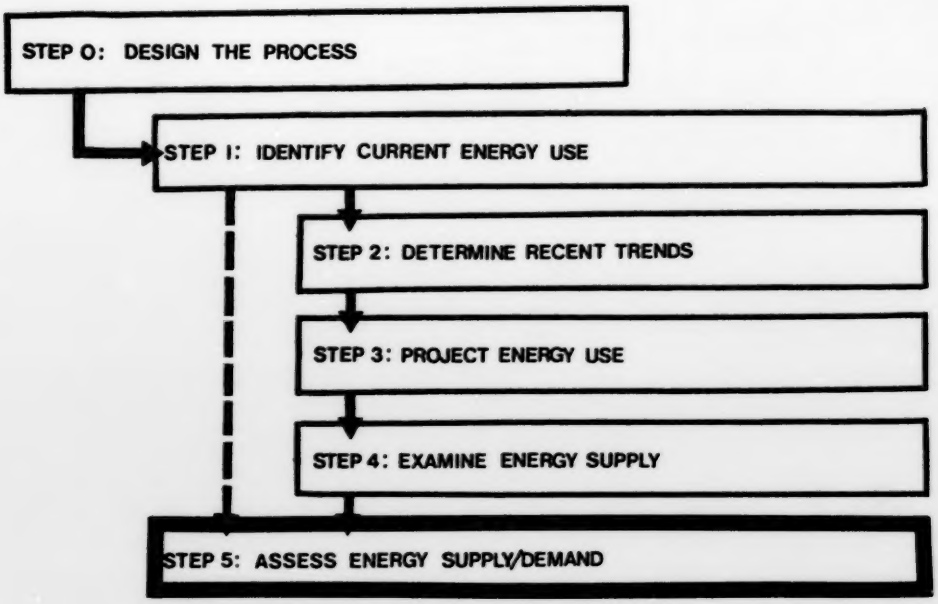
Other. Certain areas will have small-scale hydroelectric resources locally. Wind energy is a further example; average wind speeds are light over

most of Ontario but coastal areas experience sufficient mean annual wind speeds.

Conducting a local energy resource inventory in a Round 1 community energy profile involves identifying sources, the processes that might be applied to convert them to usable energy, and potential sites for resource development. Development potential is addressed in Step 5. Feasibility analyses, if needed, would be done later in the energy planning process.

Step 4.4 Summarize Local Energy Supply Situation

Provide a concise summary of the findings of Step 4.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STEP 5: ASSESS ENERGY SUPPLY/DEMAND

Step 5: Assess Energy Supply/Demand

Objective: to define the community's main energy-related problems, concerns and opportunities.

Earlier steps were descriptive; this step is evaluative. It involves an assessment of the local energy supply/demand situation to identify, in a preliminary way, the main dimensions of the municipality's energy problems, the current response to them, and the potential for new initiatives through community energy management.

Each community is likely to have its own set of evaluation criteria, reflecting unique local conditions. At the level of detail and accuracy required in a Round 1

profile, however, there will be close similarities among communities. A useful starting point is to review the following criteria and adapt them to the local context.

Criterion 1. Comparability

One obvious way of assessing the community's energy consumption pattern is to compare it with that of other communities and the province as a whole. The extent to which local energy use is above or below current "norms" can then be determined. Comparisons with regional averages for electricity and natural gas consumption may also be useful provided that such averages have not been part of the estimating techniques for calculating energy consumption in the sector, subsector or end use for which the comparison is being made.

Information sources for comparisons with provincial averages include:

Ministry of Energy, Ontario Energy Review, second edition (Toronto: The Ministry, 1981). Available from Ontario Government Publications Centre, 880 Bay Street, Toronto, Ontario M7A 1N8 ($2.50, cheque payable to Treasurer of Ontario).

Informetrica Ltd. and Energy Research Group, Carleton University, Ontario Residential and Commercial Energy Demand Study (Toronto: Ministry of Energy, 1978). Available from the Ministry.

Scanada Consultants Limited, Ontario Housing Heating Performance and Improvability (Toronto: Ministry of Energy. March 1979). Available from the Ministry.

Ministry of Treasury and Economics, Ontario Statistics. Published annually. Available from Ontario Government Publications Centre ($3.00).

Ministry of Treasury and Economics, Consumption of Fuel and Electricity by Ontario Manufacturing Industries. Published annually. Available from Ontario Government Publications Centre ($5.00).

Data sources for community comparisons in Ontario are limited at this time; this will change rapidly over the next few years as more and more municipalities conduct community energy profiles. Examples of available profile documents are provided in Appendix B of Lang and Armour, The Community Energy Profile: Concepts, Methods, Applications, March 1982 (contact Ministry of Energy).

Comparisons with other places need to be made with caution. It is important to check which fuels, sectors, subsectors and end uses were taken into account (e.g., the Oakville study, cited in one of the profile documents, omitted transportation) and to adjust either your profile results or theirs so that they match. Furthermore, the profiling methods deserve careful consideration; sometimes for example, the method simply involved borrowing directly the sectoral proportions discovered in another profile. Also, remember that a prudent cross-community comparison uses several indicators, not just one. Examples: overall per capita energy consumption alone will be misleading if the reference community is heavily dependent on a single energy-intensive industry; and comparing residential energy consumption per capita in two communities may lead to a different conclusion than if per household figures were used.

Differences between energy consumption in your community and others may be interesting and they may even provoke local concern. By themselves, however, these differences reveal little about the dimensions of the local area's energy problems. The key question is: what accounts for the differences? Explanations may relate to the industry mix, climate, age and types of housing, building siting and construction practices, availability of public transit, urban form and broad patterns of land use, income

levels and other demographic characteristics, consumer behaviours, and other factors. The main value of applying Criterion 1 is to pinpoint further lines of inquiry that may get at underlying reasons for the community's energy consumption patterns and the potential for local energy initiatives.

Criterion 2. Cost Impacts

Another approach to assessing community energy consumption is to investigate its present and future impact on the local economic base and on disposable incomes. A Round 1 profile aims not at quantifying accurately the full impact but rather at determining whether there is cause for concern. "Evidence" in this regard can be obtained through the use of various methods including:

a. Consultation with a cross-section of the local industry/business community. Do they perceive energy costs as a serious problem? What effects are energy prices having and likely to have on their operations (e.g., reduced inventory or customer service, delay or cancellation of expansion or renovation plans, layoffs, etc.)? Which kinds of businesses appear most likely to be seriously affected?

b. Analysis of energy dollar flows in and out of the community. Energy "imported" by the community means dollars exported, if local energy sources are not being used. This may constitute an undue drain on the community's economy if the dollar outflow is not balanced by local economic benefits (e.g., jobs, spin-off effects, tax revenue). For most communities, the outflow of energy dollars can be expected to far exceed local economic benefits associated with energy supply and consumption. Rising energy costs will accentuate this imbalance. At issue is the extent to which current energy consumption patterns, if continued, will contribute further to this drain on the local economy and, conversely, whether energy conservation/substitution and increased local energy production might bring corresponding economic benefits.

c. Examination of the effect of current and expected energy cost increases on the disposable income of local residents. What proportion of personal disposable income is spent on energy? How does this vary among different income groups? Has average income kept pace with oil and natural gas price rises? To what extent are people with low or fixed incomes able to handle rising energy costs? Does the per household energy consumption indicate wasted

energy, hence unnecessary household costs, and potential for coping with inflation?

Most people perceive energy problems as energy-cost problems. Therefore, the application of Criterion 2, while difficult, will be a central feature of any effective argument to motivate decision-makers to take energy-related action.

Criterion 3. Vulnerability

To be vulnerable is to be unprotected against harm. From an energy standpoint vulnerability means being susceptible to the harm that could or will result from escalating energy prices and possible supply shortfalls. Not every community is vulnerable – the opposite of vulnerability is security and self-reliance – and some are considerably more vulnerable that others. No simple method exists to assess local energy vulnerability but there are some indicators that can be used to determine whether vulnerability should be a concern. For example, a community probably is energy-vulnerable if it has one or more of the following characteristics:

- A high proportion of its residents commute to work and there is no public transit system, or the existing service is inadequate.

- A single industry dominates the local economy and that industry is energy-intensive; or the main industries on which the community's economic well-being depends are energy-intensive (See following Table) or otherwise especially sensitive to increasing energy prices).

ONTARIO'S ENERGY INTENSIVE MANUFACTURING INDUSTRIES, 1979

SIC Code	Industries	Value Added in Mfg. ($million)	Energy Cost Per $000 Value Added	Energy Cost Per Person Employed
271	Pulp and paper mills	977.1	237	10,289
378	Industrial chemicals	880.7	317	18,158
295	Smelting and refining	221.7	289	9,891
352	Cement manufacturers	136.6	377	37,575
357	Abrasives manufacturers	64.7	247	7,276
358	Lime manufacturers	23.8	772	39,681

Source: Ontario Ministry of Treasury and Economics, Consumption of Fuel and Electricity by Ontario Manufacturing Industries, 1981.

- A significant number of residents have low or fixed incomes.
- Many people in the community live in energy-inefficient houses (especially significant if a large proportion of these residents are low-income). Many of the housing units are oil-heated and substitution options are quite limited.
  A significant number of community service agencies (whether government or non-government) see their

costs rising rapidly and their revenue failing to keep pace; their only choice is to cut back on services.

The municipality possessing the foregoing characteristics does not have a contingency plan to ensure that, in the event of a shortfall, essential energy-related services will continue until federal/provincial allocation measures can take effect.

An examination of energy vulnerability should include consideration of the future as well as focus on the present. And it should recognize that certain parts of or groups within the community may be more vulnerable than others.

Criterion 4. Conservation Potential

"Energy conservation" here refers to efforts aimed at reducing consumption, minimizing energy waste and increasing energy efficiency – overall and/or for selected fuels/sectors/subsectors/end uses. The potential to conserve energy, and thereby avoid unnecessary costs and lessen other adverse impacts, is considerable in every community.

"Conservation potential" generally expresses the gap between the present level of energy use and a level that might be achieved under certain conditions. These conditions have to be specified. A large difference may

exist between: 1. the level of energy consumption that is technically feasible irrespective of cost (e.g., super-insulating, through retrofit, an old masonry house); 2. the economically optimal level (e.g., insulating the attic); and 3. the current "price-driven" level (e.g., weatherstripping and caulking). Although much of the conservation potential may be achievable without expenditure or sacrifice, part of it undoubtedly will require investment to secure desired returns; part of it may even require extraordinary incentives to make investment happen. Obviously, economic variables and related institutional factors that shape what is "economic" are most important, but the way individuals and corporations regard such things as payback matter too.

In a Round 1 profile only a rough approximation of energy conservation potential is needed. It is sufficient to demonstrate that something can be done and, if it is, that benefits will follow (this is the reverse side of the argument that adverse consequences will occur if present levels of energy consumption continue). The Round 1 analysis focuses on broad categories rather than on the feasibility of specific measures; that comes in a later stage of the community energy management process. Also, emphasis is on the aggregate community scale, rather than on the individual user.

Methods for exploring energy conservation potential cover a wide range, including:

- Adapting, to local conditions, findings from general studies and other energy profiles regarding percent savings possible in various sectors, subsectors and end uses as well as optimal levels of energy consumption. For example, the Ontario Energy Review indicates that oil and gas heated homes should be able to achieve, on average, a 25% saving in heat requirements through thermal upgrading; half of this is possible for apartments.
- Direct analysis of community characteristics. Example: if the community has a large proportion of pre-World War II houses (little insulation, high infiltration rates, etc.) that show higher-than-average estimated fuel consumption, and if many of these units are of wood frame construction (sizable wall cavities permitting the needed insulation), this indicates considerable potential for straightforward quick-payback conservation measures in the community's residential sector. Another example: a large proportion of older 8-cylinder automobiles, or many single-occupancy vehicles, or a low modal split all indicate sizable potential for energy conservation in the transportation sector.

- Use of Scanada's Canada 2 model (tested in Peterborough and summarized in Scanada Consultants Ltd., Ontario Housing Heating Performance and Improvability, for the Ontario Ministry of Energy, 1979). This model can estimate a community's current residential heating demand, fuel requirements and costs, compare these figures with estimates for the housing stock as upgraded, and derive potential energy savings and payback periods.
- Identifying representative building types in the community's residential and commercial sectors and preparing case studies of current and potential energy consumption.
- Using thermography to identify the extent and distribution of energy-inefficient structures.
- Consulting with representatives of business and industry to arrive at estimates of local conservation potential in these sectors.
- Taking advantage of energy audits already done (e.g., by local utilities, individual owners, etc.) and other special studies.

Energy conservation can be assessed for present conditions; initially, that may be sufficient. If possible, however, potential should also consider the future, comparing current energy use not with what might be

achieved in general but instead with the probable level of energy consumption at some specified target date, such as 1990. This would take into account conservation actions that can be expected to occur in any event (as a result of federal and provincial programs and through voluntary efforts stimulated mainly by rising prices) without intervention from the municipal government.

Criterion 5. Substitution Potential

"Substitution" refers to reducing the use of critical fuels by promoting the switch to alternative energy forms and generally, to renewable resources. The main fuels of concern in Ontario are heating oil and gasoline. Substitution potential therefore focuses on the extent to which conversions, to other energy forms in place of oil for space heating and away from gasoline for transportation, may be achieved. Substitution is closely linked to conservation which emphasizes improving the efficiency of and reducing the use of these critical energy forms.

Assessing substitution potential involves:

- Examining the extent to which critical fuels, including any of special concern to the community (e.g., a shortage of firewood in an area where many

people have wood stoves), are now and are projected to be consumed in the community.

- Considering the extent to which substitution is possible and feasible locally (e.g., some oil furnaces are easily converted to other fuels while others are not, and some people are better able than others to afford the changeover) through methods such as case studies and consultation.

Criterion 6. Potential for Local Energy Production

Developing local energy resources, or at least protecting them for possible later development, can be a means of countering vulnerability. Here, the results of Step 4 are assessed and a summary is presented to indicate the potential that exists to take advantage of energy resources available in the community or region.

Criterion 7. Community Propensity Toward Conservation and Substitution

Local demand and support for energy-oriented action - by local residents, business people, community organizations, the media, and elected and appointed municipal officials - is vital to a successful community energy management program. The extent to which it is

present, therefore, is a major determinant of the strategy to be followed in developing such a program. In a Round 1 profile, the objective is to get a rough indication of the local propensity to conserve energy and substitute away from critical energy forms. Key questions are: To what extent are such actions already being taken or under consideration? Is there latent support, perhaps even demand, for further action, especially action taken or promoted by the municipal government? And what perceived barriers appear to block such action?

Various methods can be used to answer these questions, including:

- Interpretation of recent trends in community energy use (Step 2) to get at an apparent propensity to conserve energy and bring about substitution, under present conditions.
- Consultation with the local energy utilities to find out how much interest is being shown in conservation and substitution measures (information requests, building audits, conversions, etc.) and in information campaigns.
- A check with local building suppliers and contractors to see whether local sales of conservation products (such as insulation) and services are on the increase.

- Examination of local uptake rates for government conservation and substitution programs (note that data on CHIP are available only at the province-wide level).
- Consultation with a cross-section of representatives of various user groups (local elected representatives, municipal officials, members of the business community, ratepayer organizations, etc.) to ascertain their views on energy problems, find out what their members are already doing, and determine the degree of support they might give to further energy actions sponsored by the municipality.
- If time and resources allow (this might be left until Round 2), conduct of a sample attitude survey with the same objectives as the previous method.
- Examination of the results of any special studies in the community (such as the Ontario Hydro pilot energy audit surveys in Brampton and Aurora) as indicators of consumer interest in energy conservation/substitution. Also, examination of the results of community-oriented studies elsewhere (such as North York's Community Home Energy Action Program and Toronto's Energy Conservation Community Outreach Project) that may have local relevance.

Criterion 8. Unique Local Concerns and Problems

Here add any criteria that are required to reflect unique local conditions.

Each of the foregoing criteria probes a particular aspect of the local energy supply/demand situation. Together they form a basis for a first-round assessment of community energy use patterns. This assessment should reveal which fuels, sectors, subsectors and end uses are problematic (Criterion 1) the main concerns associated with each (Criteria 2, 3 and 8), a rough indication of the potential for energy conservation/ substitution/production (Criteria 4, 5 and 6), and the likelihood of the community accepting and carrying out energy management initiatives (Criterion 7).

The final part of Step 5 is to summarize the local energy situation. A concise, easily understood presentation format is recommended. Profile results are likely to receive wide circulation and therefore must be comprehensible to a broad range of readers. Furthermore, since the Round 1 profile is an input to the initial setting

of community energy objectives, it is important that the summary document be presented in a manner that helps these discussions to be fruitful.

Appendix

Energy Units

Energy consumption involves the conversion of energy latent in nature to heat, and in particular the controlled generation of heat and light by end-users (Ontario Energy Review).

Primary energy is energy derived from natural sources such as oil, natural gas, falling water, uranium and geothermal. The primary fossil fuels are measured in physical units: barrels (or cubic metres) of oil, cubic feet or therms (or cubic metres) of natural gas and tons (or tonnes) of coal.

Secondary energy is the energy delivered to the final consumer (e.g., gasoline, diesel fuel, heating oil, electricity). The difference between primary and secondary energy is the energy lost in the process of conversion and supply.

Community energy profiles tend to focus on secondary energy. It is important to be aware, therefore, that they do not include energy lost in the conversion process. Also

excluded is embodied energy – the amount of energy expended to produce a given object.

Thermal value of various forms of energy is expressed in British Thermal Units and the metric equivalent, joules. A BTU is the quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit at sea level atmospheric pressure. A joule (J) is the quantity of heat required to raise the temperature of one gram of water by one degree Celsius.

Thermal values of the main energy forms are shown below for both Imperial and metric units.

Energy Form	Imperial Units
Petroleum	1 barrel (bbl) = 35 gallons* = 5.8×10^6 BTU
	1 gallon of #2 heating oil = 165,000 BTU (average value)
	1 gallon of motor gasoline = 150,000 BTU (average value)
Natural Gas	1 therm = 1 million cu. ft. (MMCF) = 1×10^9 BTU
Electricity	1 kwh = 1,000 watts = 3,413 BTU at point of use

* Refers to Imperial gallons
1 U.S. gallon = 0.833 Imperial gallons
1 barrel = 42 U.S. gallons

Energy Form	Metric Units
Petroleum	1 cubic metre of crude oil = 38.512×10^9 joules
	1 litre of motor gasoline = 34.656×10^6 joules
Natural gas	1 cubic metre = 37.299×10^6 joules
Electricity	1 kwh = 3.66×10^6 joules

Metric Conversion

1 cubic metre of crude oil = 6.293 barrels

1 cubic metre of natural gas = 35.3 cubic feet

1 Imperial gallon = 4.55 litres

1 cubic metre = 1000 litres 1 cubic foot = 28.3 litres

1 BTU = 1055.06 joules 1 joule = 0.0009478 BTU

Scientific Notation

Energy units are quite small and therefore the amounts of energy measured tend to be quite large, typically in the millions, billions and trillions of BTUs or joules. Scientific notation is commonly used to make the recording of these large numbers less cumbersome.

Prefix	Symbol	Value	Meaning
kilo	k	10^3	thousand
mega	M*	10^6	million
giga	G	10^9	billion
tera	T	10^{12}	trillion
peta	P	10^{15}	quadrillion

* Sometimes also used to mean thousand, as in MCF = thousand cubic feet (commonly used by gas companies).

The use of a calculator that has the scientific notation function can expedite computations during the conduct of a community energy profile.

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Robert Welch,Q.C.
Minister

Energy
Ontario